DAIRYING 2000

OPPORTUNITIES FOR THE NEW MILLENIUM

NATIONAL DAIRY CONFERENCE 2000

16 NOVEMBER 2000

SILVER SPRINGS HOTEL, CORK

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SILVER SPRINGS HOTEL, TIVOLI, CORK

THURSDAY, 16 NOVEMBER 2000

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OPTIMISING PROFITS ON DAIRY FARMS

Dermot McCarthy, Chief Dairy Advisor, Teagasc

Introduction

This paper examines returns on dairy farms in terms of profitability and rates of return on capital. Factors influencing returns including production cost per gallon, yield per cow and lactation length are examined in some detail. Some conclusions are drawn on how best to optimise dairy profits both at farm and policy level.

Current levels of farm profitability

Income on dairy farms is measured each year by the Teagasc National Farm Survey. This is based on a sample of almost 500 dairy farms. Results for 1999 show that average family farm income for specialised dairy farmers was £18,300 and £16,400 for dairy farmers with other enterprises.

The family farm income figure of £18,300 represents a return to capital, family labour and management. This figure derives from an average holding of 35.7 ha, 39 cows and a quota of approx. 38,000 gallons. The average dairy farmer in this category is 48 years of age. On 11.5% of dairy farms in this category the dairy farmer has an off farm job (mainly in smaller herds) and on 22.2% of dairy farms the partner of the dairy farmer has an off-farm job (mainly in the larger herds). The average family farm income of £18,300 hides a considerable variation in dairy farm incomes. Dairy farms owning less than 30 ha had an average family farm income of £11,863.

Income per family labour unit

Average family farm income per farm for 1999 looks respectable, relative to the average industrial wage of £16,761 for the same year. However average family farm income derives from 1.36 labour units so that these figures are considerably diluted when converted to income per labour unit. Table 1 following shows income per family labour unit on specialised dairy farms.

Table 1. Income per Family Labour Unit on Specialised Dairy Farm

	Bottom Third	**Middle Third**	**Top Third**
Income per labour unit (£)	3,391	10,874	30,129
Yield / Cow (gals)	834	994	1,102
Number of Cows	21	37	59
Farm Size (ha)	22	36	49

Source: Teagasc NFS

These data show a serious problem in terms of income per labour unit on small dairy farms. As a result, we are likely to see a big drop out in numbers. Off-farm opportunities are likely to lure away potential successors on such farms and a new Early Retirement Scheme will encourage those over 55 to call it a day.

In a period of static product prices for the foreseeable future we will have to look towards increased production efficiency, increased labour efficiency and increased scale / quota size to improve this income situation.

In my paper at last year's conference I stated that dairy farmers will need to increase scale by one third and increase efficiency to maintain income in real terms during the course of the Agenda 2000 agreement. I also stated that 40,000 gallons will be needed to give an average industrial wage. However to get best labour and economic efficiency and improvement in working conditions, we should encourage amalgamations of small units through partnerships to bring production unit quota size up towards 80-100,000 gallons. We are likely to see partnership regulations to facilitate partnership formation under tightly defined circumstances in the near future and this development is very welcome. Long term, we should aim to make partnership the mechanism to painlessly restructure our dairy industry. Partnership regulations should be flexible to allow a number of partners to come together to reach a target quota size of 80-100,000 gallons and to allow some partners to exploit off-farm employment. Priority access to quota should be given to dairy farmers working to a farm plan within partnerships.

Rate of return from dairy farming

When evaluating any business, profit levels must be assessed in the context of the capital tied up in that business. Internal rate of return is accepted as the best method of evaluating investment opportunities. Simply put, this methodology compares the cost of an investment to the annual net cash flows plus cash-in value of that investment. The returns are expressed as a percentage rate, based on the initial investment.

Example

Year 0 Cost of Share	£10
Year 1 – Dividend	20p
Year 2 – Dividend	20p
Year 3 – Cash in Value of Share	£11

Internal rate of return (pre tax) for this investment is 4.55%. This return is a measure of the annual net cash flow (dividend) and the capital gain on cashing in (£1) the share.

Applying the same methodology, the returns from some sample investments over the period from the mid-1970s to 2000 were examined and compared with dairy farming. Approximations and assumptions were made where necessary.

	APPROX. INTERNAL RATE RETURN
Share in Financial Institution 1974 → 2000	16%
Investment in a Dublin property 1980 → 1997	13%
Investment in a Dublin property 1974 → 2000	25%
Investment in a dairy farm (pre labour) 1974 → 2000	16%
Investment in a dairy farm (post labour) 1974 → 2000	13%

* No payment to family labour
** Family labour paid based on agricultural wage

These returns would indicate that potential annual returns from dairy farming (assuming top management) over the past 25 years were more or less in line with other investments though not up to the dizzy heights of an investment in Dublin property. In calculating this rate of return a land purchase price of £800/ac was assumed in 1974 and a sale price of £7,000/ac including quota was assumed.

Current and future rate of return

Current rate of return for an investment in a dairy farm is potentially in the 4 to 6% range (pre family labour charge) on the assumption that prices remain at today's levels into the future and that quotas remain.

The main reason for this lower rate is low net annual cash flows relative to the high price of land. Increasing the long term 'cash in' value of the investment has only a small effect on rate of return.

These figures indicate that investment costs in dairying today are way out of line with potential returns. While reducing the capital cost of buildings and increasing efficiency of production will help returns, the clear indications are that land is currently making double its value based on historic rates of return.

Optimising profits

Optimising returns from the dairy herd means keeping common costs under 40p/gal. and perhaps closer to 30p on many farms. In controlling costs per gallon we have two tools, namely – cost per cow and yield per cow. While we tend to concentrate on the former, the latter should not be ignored and we should always aim to get the highest possible yield per cow from any given level of inputs per cow. Table 2 shows that increasing yield (say through better grass management) or reducing cost per cow while maintaining yield can be used separately or together to reduce cost per gallon.

Table 2 Reducing Cost per Gallon

£300 cost/cow 1000 gals	=	30p cost/gal	Base Line Situation
£250 cost/cow 1000 gals	=	25p cost/gal	Using Cost Reduction
£300 cost/cow 1200 gals/cow	=	25p cost/gal	Using Yield Increase
£250 cost/cow 1200 gals/cow	=	21p cost/gal	Using Cost Reduction & Yield / Increase

Reducing cost per cow or targeting a yield per cow should never be seen as goals but only as important tools in reducing production cost per gallon.

Reducing production costs per gallon

Analysis of farm production costs followed by concerted efforts to reduce same through better financial planning and grassland management has given positive results on dairy farms. Results from discussion groups shown in Table 3 for the years 1997 to 1999 indicate cost reductions were achieved despite bad weather conditions in 1998 and a carry over effect into 1999

Table 3. Trends in Costs in Discussion Groups

	COMMON COSTS P/GAL
1997	43.3
1998	41.0
1999	37.9
Improvement	5.4

(Source G. Ramsbottom / T. O'Dwyer).

Despite very significant efforts by Teagasc in recent years and much publicity in the farming press, less than 10% of dairy farmers have done a formal detailed analysis of their figures using Profit Monitor. This is a situation that must change rapidly if dairy farmers in general are to make the kind of financial progress outlined above.

To better cater for the advisory needs of commercial dairy farmers, Teagasc will in the near future re-organise its advisory services. Specialised dairy advisors will provide a 'Business and Technology Service' involving a major emphasis on financial analysis, financial planning and twice yearly financial progress reviews. Financial progress relative to plans will be reviewed at all discussion group meetings and individual client contacts in May and September. As part of this programme, Profit Monitor has been upgraded to allow easy preparation of financial plans and to monitor progress. In a further development we expect to have these programmes available to clients via the internet early in the new year.

Yield per cow

Increasing yield per cow through better grassland management and sensible use of inputs will lead to higher profits from a given quota *(Cross – IGAPA Journal, 1996).* Increasing yield through increasing genetic merit will increase margin/litre provided replacement rate does not increase drastically. Table 4 compares results for herds of differing genetic merit based on three years research at Moorepark and Castlelyons.

Table 4 Margin per litre and Cow Genetic Merit

	Low Genetic Merit *Holsteins*	**Medium Genetic Merit** *Holsteins*	**High Genetic Merit** *Holsteins*	**Montbeliarde**
	Castlelyons Herd	*Moorepark Herd*	*Moorepark Herd*	
Margin/litre (p)	11.2	13.5	12.2	13.1
Rep Rate %	20	14	30	14
Yield / Cow (gallons)	1173	1407	1632	1187

(Source – A New Agenda for Dairying, 1999, Dillon, Moorepark)

As yield per cow changes, the capital investment involved in producing any given level of quota alters. This means that looking at the ongoing cash flows from a production system in isolation is not sufficient to tell which system is best. Table 5 attempts to model the results from contrasting systems of production, taking production levels within the normal range found in commercial production in Ireland.

Table 5 Model Comparison of Contrasting Production Systems for 100-Acre Farm With 75,000 gallon Quota and Cattle

	1000 gals/cow 300 kg meal 20% Rep Rate	1400 gals/cow 700 kg meal 20% Rep Rate	1400 gals/cow 700 kg meal 30% Rep Rate
Present Value of Income (5%) £	10,000	143,000	91,000
Rate of Return %	5.08	6.2	5.7
Annual Cash Surplus (pre tax, interest & labour)	51,400	59,300	55,860
Total Investment	912,000	893,000	893,000

Present value of income in table 5 is calculated by discounting future cash flows at 5% per annum. Table 5 shows that the higher yield scenario has the best present value of income, the best internal rate of return on investment, the best annual cash surplus and the lowest total capital tied up. However, for a fixed quota situation as in the above model, differences in any of these measures are relatively small so that in some situations farmers doing 1000 gals well may end up better than others doing 1400 gals poorly. If higher yield per cow is accompanied by high infertility, then much of the potential gains from higher yields may be lost. In the above model an increase from 20 to 30% in replacement rate results in an additional cost of 4p/gal for the 1,400 gallon herd. In a non quota situation this figure would be higher. In the model above, extra replacements replace drystock. In a non-quota situation extra replacements would take the place of cows thus greatly increasing the cost of infertility.

Lactation length

Another factor affecting yield per cow is lactation length. Again a model approach has been taken to examine the effects of reducing lactation from 305 days to 230 days. Cows on long lactation are assumed to get 2½ kg meal per day for the period of the extended lactation and consume extra silage.

Table 6 shows that reducing lactation length from 305 days to 230 days reduces yield by 174 gals per cow where our starting point is an 1100 gal herd. Meals are reduced for the short lactation but milk price falls by 3p/gal. Only half this milk price fall is assumed in the following paragraph as a quota butterfat adjustment would neutralise some of the better milk composition figures for the long lactation.

Table 6 Examination of Shortening Lactation to Produce a 110,000 Gallons

Lactation Length (days)	305	230
Yield / Cow (gals)	1100	926
Number of Cows	100	118
Meal @ £140 / ton	£68	£44
Price / Gal £	1.03	1.00
Margin over Meals £	106,736	105,086

Margin over meal is not a proper measure to evaluate the merits of differing lactation lengths. To do this all costs and levels of capital investment were modelled for a 100 acre farm producing a 55,000 gallon quota plus drystock. Capital investment tied up in land buildings and stock was estimated, as were future cash flows on the assumption of static prices and quotas continuing.

For this size quota, annual farm cash flow was £3,000 higher for the longer lactation and internal rate of return was 5.6% as against 5% for the shorter lactation length.

Reducing from 305 to 230 days is extreme. Smaller reductions to perhaps 270 to 280 days will have a relatively small effect on cash flow and the penalty in terms of extra cows to be milked and capitalised will be much smaller.

Sustaining yield per cow

Sustaining yields of 1400 gallons per cow under our current grassland management systems is likely to prove difficult without losing out on cow fertility as genetic merit of our dairy herd rises. In the absence of a scientific break through to improve matters in this area, our best short-term option is selective crossbreeding. Whilst we do not have research information on possible crossing breeds other than Montbelliardes and Nordmende we do have performance information and proofs for bulls of various breeds. These proofs can be used to select the best bulls from potential crossing sires. Crossing with top Montbelliards, Nordic breeds and others can introduce a level of hybrid vigour into our herds, which would make yields of 1400 gallons per cow more sustainable on a grass-based system.

Conclusion

- Income per labour unit is low on half our dairy farms. Very small units will find it difficult to compete with off-farm employment, even where farms are well managed.
- Amalgamations of small units through partnerships to bring individual unit quota size up towards 80-100,000 gallons should be encouraged.
- Rate of return for capital investment in dairying is low currently. Land price will have to reduce by half to rectify this situation.
- Optimising returns from dairying within the farm gate means reducing common cost per gallon to the 30 to 40p/gal range. Profits can be increased on most dairy farms through financial performance analysis, financial planning and twice yearly financial reviews.
- Cost per cow and yield per cow should be used as tools to reduce cost per gallon rather than be seen as targets in their own right. Higher per cow yields can increase potential returns but these are not always realised.
- A lactation length of 270 to 280 days represents a good compromise between the income loss due to shorter lactation and the benefits gains for labour by having a complete break in production for a reasonable period.
- Finally, dairy farmers should begin to capitalise on the benefits of crossbreeding.

GRASS UTILIZATION AND GRAZING MANAGEMENT FOR DAIRYING

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Introduction

Grassland management for profitable dairying embraces the dual objectives of grazing pasture *in situ* by dairy cows and also conserving surplus grass as high quality silage. The integration of both of these objectives in practice is important for success in each one. The proportion of the grassland area used for silage determines the amount of grass available for grazing. This paper will focus primarily on achieving high performance from grazed pasture. Effective stocking rates at various points during the grazing season generally are determined by what is needed to feed the cows sufficient pasture, given average grass growth rates for those times.

The developments in grazing technology over the years have resulted in improved levels of milk production as well as improved milk composition. A realistic target for many technically efficient dairy farmers using this system is 6,000 litres (1,320 gallons) milk per cow with fat content of 3.9% and a protein content of 3.4%. This level of performance is achievable at a stocking rate of 2.6 cows/ha with a nitrogen input of 380 kg per hectare and a mean calving date in late-February/early-March. The inputs per cow include 500-600 kg concentrates, 3.5 tonnes (DM) of grazed grass and 1.4 tonnes (DM) of silage. Over half of the concentrates are fed in the spring/early-summer period and the remainder in the autumn (October to December). The main adjustment needed to this system for wet land or for the more northern areas of the country is an increase in silage allowance per cow and a reduced overall-stocking rate. Grazing management skills are also more demanding, especially during adverse weather conditions on heavy soil types. Using this approach a total yield of 450 kg of fat and protein per cow (300-day lactation) is possible.

Summary of grassland management (annual and medium-term feed budget)

Grazing grass *in situ* at a reasonable level of utilization will remain the simplest and most efficient method of converting grass to milk. It is also generally accepted in Ireland that rotational grazing is the most practical and reliable method of utilizing grass. However, it is only at high stocking rates that production increases are actually achieved when compared to continuous grazing. Efficient grazing management is facilitated by farm layout, which entails good farm roadways and paddocks with an adequate water supply. The challenge under Irish conditions is to maximise the amount of grass grown (12-14 t DM/ha) through grazing. The *annual feed budget* determines the annual stocking rate linked with the appropriate nitrogen requirement, as previously outlined. The *intermediate feed budget* will determine the date of start of grazing, when to close-up for silage and what proportion of the farm should be closed for silage.

It is recommended that, on dry land, all of the farm should be grazed initially, with the initial grazing starting in early-March if grass supply and weather conditions permit. This may not be possible in all years, especially on difficult wet land. Early nitrogen application and the correct timing of final autumn defoliation facilitate early grazing. However, due to the low growth rate in early spring, grass supply will not be adequate to meet the herd’s demand when first turned out to grass. With compact spring-calving and stocking rates of 2.6 - 3.0 cows per hectare, daily grass growth will not be adequate to meet the herd’s demand until mid to late-April. Therefore, up to that date and depending on turnout date, grazed grass will only constitute part of the herd's diet. It is important that the first rotation should not finish before mid to late-April. Concentrates may be introduced two weeks before the start of lactation so as to allow the rumen to adjust to the change in feeds. Concentrate feeding should be fed at a level of 4-5kg per cow per day post calving when grass can be included in the diet in early spring. For longer indoor feeding periods in spring, concentrate feeding should be increased to 7kg per cow per day. As the availability of grass increases in spring, concentrate feeding should be phased out.

The first week of April is proposed as the key period for closing off paddocks for 1*st* cut silage. At a stocking rate of 2.6 cows per hectare, 45 to 50% of the total area can be closed at this time, resulting in a stocking rate of 4.5 to 5.0 cows per ha on the grazing area. However, depending on grass-growing conditions in any one year, this can be increased or decreased. A silage yield of 7 tonnes of grass DM per ha is achievable under good management. This will produce 28 tonnes per ha of settled silage with 20% DM cut in late-May, allowing for 20% losses due to ensiling. In the grazing area, tight grazing to 6 cm during this period (late-April to end of June) is critical. Grazing management in this period is critical for the remainder of the season. The benefit of lenient grazing (8-10 cm) during this period is small (68 litres milk per cow). However, the loss in milk yield for the remainder of the season due to deterioration in sward quality is much larger (410 litres milk per cow). Another option is to top leniently grazed pastures to the required post-grazing sward height (6 cm) during May and June. This has been shown to be feasible and this may be an important strategy in difficult grazing conditions. Stocking rate on the grazing area is reduced to 4 to 4.25 cows per ha in mid to late-June as a result of releasing of about 10% of total farm area for grazing after 1*st* cut silage.

The second silage crop is cut 7 to 8 weeks after the first cut (10 to 20th July). A silage yield of 4.5 - 5.0 tonnes of grass DM per ha is achievable under good management to produce 18 tonnes per ha of settled silage with 20% DM. This will provide a total of 7 tonnes of settled silage (20% DM) per cow at an overall stocking rate of 2.6 cows per ha from the two silage cuts. From mid- to late August onwards, the total farm is available for grazing. During this period (July to September), grazing pressure may be relaxed to allow a post-grazing sward surface height of 7-8 cm in order to increase milk yield per cow without resulting in deterioration in sward quality afterwards.

The grass available in early spring is a combination of the grass carried over from the previous autumn plus the grass that grew over the winter. Results from Moorepark experiments have shown that delaying closing pastures from late-October until early December reduced spring yield of grass by 500 kg DM/ha for a removal of 300kg DM/ha in the previous autumn. Therefore, the loss in yield of grass dry matter at turnout is not balanced by the grass harvested in the late autumn/early winter grazing. It is difficult to be precise about the optimum closing date, as it will vary from year to year, depending on grass-growing conditions. As a general guide, in an intensive spring-calving situation, the last rotation should start in late-October, with a cessation of all grazing by mid-November.

Supplementation with concentrates (from late-September) and silage (mid- to late-October) maintain milk production in the September to November period. The milk produced over this period is high in fat and protein content and good in terms of milk processing characteristics.

Short-term budgeting

The short term feed budget refers to the application of the targets for grazing intensity, daily allowance of grass and farm cover measurement over a period of time, which would coincide with a grazing rotation. This budget is done with a focus on the short-term supply of grass and the performance of the cows. Three terms, which are central to short term feed budgeting, are described below for the sake of clarification later.

Farm Cover (of grass)

Farm cover refers to the total farm supply of grass. It is the amount of dry matter (kg DM) per hectare above 4 cm from ground level. It is the average supply of grass across all the grazing paddocks. Grass supply during the grazing season is typically wedge-shaped, with the highest point of the wedge coinciding with the paddock that is immediately due for grazing and the lowest point occurring on the last paddock grazed. The grass supply is measured as available grass for grazing above 4 cm and material below 4 cm is ignored. For example, grass yield on the next paddock for grazing might be 2000 kg of grazible DM/ha (15-18 cm high). The last grazed paddock would have being grazed down to 500 kg of DM/ha, while the other paddocks would be in various stages of recovery. The total farm cover might equal 1,100 kg DM/ha.

Farm cover can be described also as the total supply of grass per cow. This equals farm cover divided by effective stocking rate. If the effective stocking rate in May is 4.5 cows/ha and the farm cover on the grazing area is 1,000 kg DM/ha, then there is 222 kg DM/ha/cow available. This is equivalent to about 11 days grass for the herd. This is a more useful measure of farm supply of grass as comparisons across farms with different stocking rates and/or conservation strategies are possible.

Daily Herbage Allowance (DHA)

This term refers to the amount of grazible grass available to the herd over a short grazing period in a paddock. If there are 22 paddocks (of 1 ha each) being grazed by 100 cows and the paddock in question has a yield of 2,000 kg DM/ha above 4 cm and the residency time in the paddock is 24 hours, then the daily herbage allowance is 20 kg DM/cow (kg DM/ha ÷ Cow No. by days). It is convenient to use the unit kg DM/cow/day for daily herbage allowance (DHA) even if paddocks are being grazed with a residency time of greater than or less than one day.

It is important to bear in mind that DHA under controlled grazing management is a reflection of farm cover and the amount of grass made available for grazing by the farm manager. The methods whereby the farm manager may alter the level of DHA are as follows: altering the residency time in a paddock (i.e. from 24 to 36 hours) or altering the area grazed each day (from 1.0 to 1.1 ha, as an example). The effective result will be to make more grass available and the rotation length will shorten. The opposite may also be cited.

Post-grazing Sward Surface Height (PGSSH)

The PGSSH refers to the undisturbed height of the sward in a paddock immediately after grazing-down. It is a convenient way of describing the intensity of grazing. The height range would generally fall in the range of 4 to 8 cm. It is the average height across the paddock surface and includes the tall, partially grazed, grass areas as well as the short, well-grazed, grass areas. It has a very specific relationship to DHA. When the DHA is too low for the requirement of the cows, then the PGSSH will be low. Conversely, when the DHA is very high, the PGSSH will be high.

PGSSH, measured with a sward stick or ruler, is higher than the compressed sward height of the rising plate meter and is lower than the extended tiller height of a sward after grazing. Care should be exercised in making comparisons across trials where different methods of measuring height are used.

Pasture/grazing effects on intake/production

The three main factors, which affect the production and intake of grazing cows, are pasture quality, allowance of pasture and ground conditions. Pasture quality refers principally to the digestibility of the herbage and is highly related to green grass leaf content. There is a linear increase in intake with increasing forage digestibility up to levels of circa. 75% Organic Matter Digestibility (OMD). However, in grazing, the situation is much more complex. Pasture digestibility changes are associated with both chemical and structural changes in the sward as well as herbage mass and allowance. Hodgson (1977) showed that intake of herbage was linear with respect to diet digestibility up to values of 83% OMD with dairy cows and growing calves. Selective grazing introduces another level of complexity in that sward digestibility differences do not reflect themselves in similar differences in the diet selected.

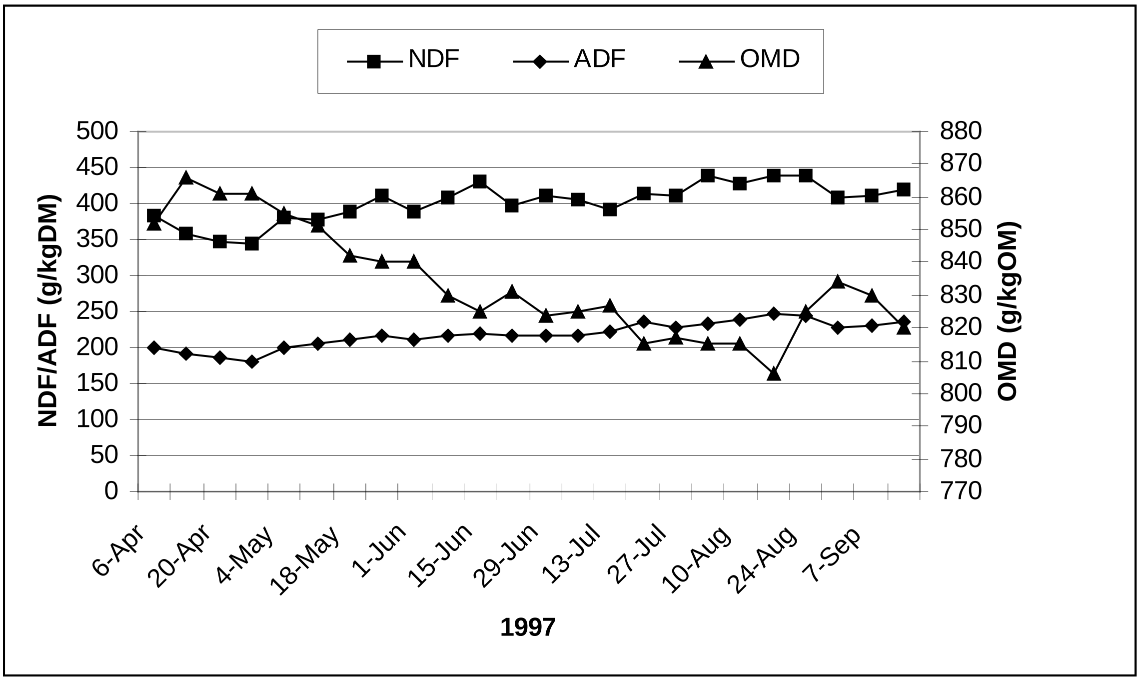
Table 1 shows the nutritive value of well managed grazed grass for milk production.

Table 1 Chemical composition of grazed grass (g/kg dm)

Crude Protein (CP)	180-250
Neutral Detergent Fibre (NDF)	350-400
Acid Detergent Fibre (ADF)	180-250
Water soluble carbohydrates (WSC)	150-200

Figure 1 shows the chemical composition of grass (pre-grazing samples above 4 cm) across the season for 1997 from a grazing experiment at Moorepark (*Buckley, 1999).* Digestibility is a key nutritive parameter and is a major determinant of the metabolizable energy content of grass. Control of grass digestibility and hence metabolizable energy content is a critical element of grazing management for milk production in Ireland (Stakelum and Dillon, *1990)*. This approach is very different to other countries (for example New Zealand and Australia) which also produce a large proportion of their milk from grazed pasture. Neutral detergent fibre concentrations of 50 to 60% are not uncommon in New Zealand and Australian pastures in mid-summer (Ulyatt and Waghorn, 1993*)*. Mid season digestibility can be as low as 65% OMD (Ulyatt, 1980*)*. This is mainly as a result of the high mid summer temperatures combined with moisture deficits. Pastures in these hotter environments also contain many sub-tropical species (Paspalum and Kikuyu as examples) which can be quite low in digestibility in summer. Therefore, animal production from grazed pasture in Ireland has a big advantage over those countries. It is possible with good grazing management to produce a feed of high quality over the whole grazing season. This feed is equal to, and at times superior to, the feed value of concentrates rations.

Figure 1 Chemical Composition of Grazed Grass over a Grazing Season



Major factors affecting sward digestibility

Sward digestibility is considered here in grazing as the major nutritive parameter. It is also the one which is most influenced by grazing and defoliation management.

1. Season and Harvest Interval

The OMD of herbage changes throughout the season (Morgan and Stakelum, 1987). Figure 2 outlines the *in-vivo* OMD of herbage at two feeding levels to lactating dairy cows for two harvest intervals. The lowest OMD generally occur in July and August. The data in Figure 2 refer to re-growths. The primary Spring herbage in late-March/early-April is usually in the range of 84-86% OMD. In general, a harvest-interval increase of 4 weeks reduced herbage digestibility by 4 and 4.6 units at the high and low levels of intake, respectively. The average change in OMD with increased intake was –2.7 units which, when expressed as change in OMD per unit increase in intake, when intake is expressed as multiples of maintenance, was -1.95. It is clear that rest or re-growth interval has a larger effect on OMD in the April to June period than in the August to October period. In another experiment (Stakelum and Dillon, 1989), the effect of 3 and 5-week rest intervals on herbage OMD was studied in the critical April to June period. There was a 0.7, 4.1 and 2.4 unit difference between the 3 and 5-week intervals, for April, May and June, respectively.

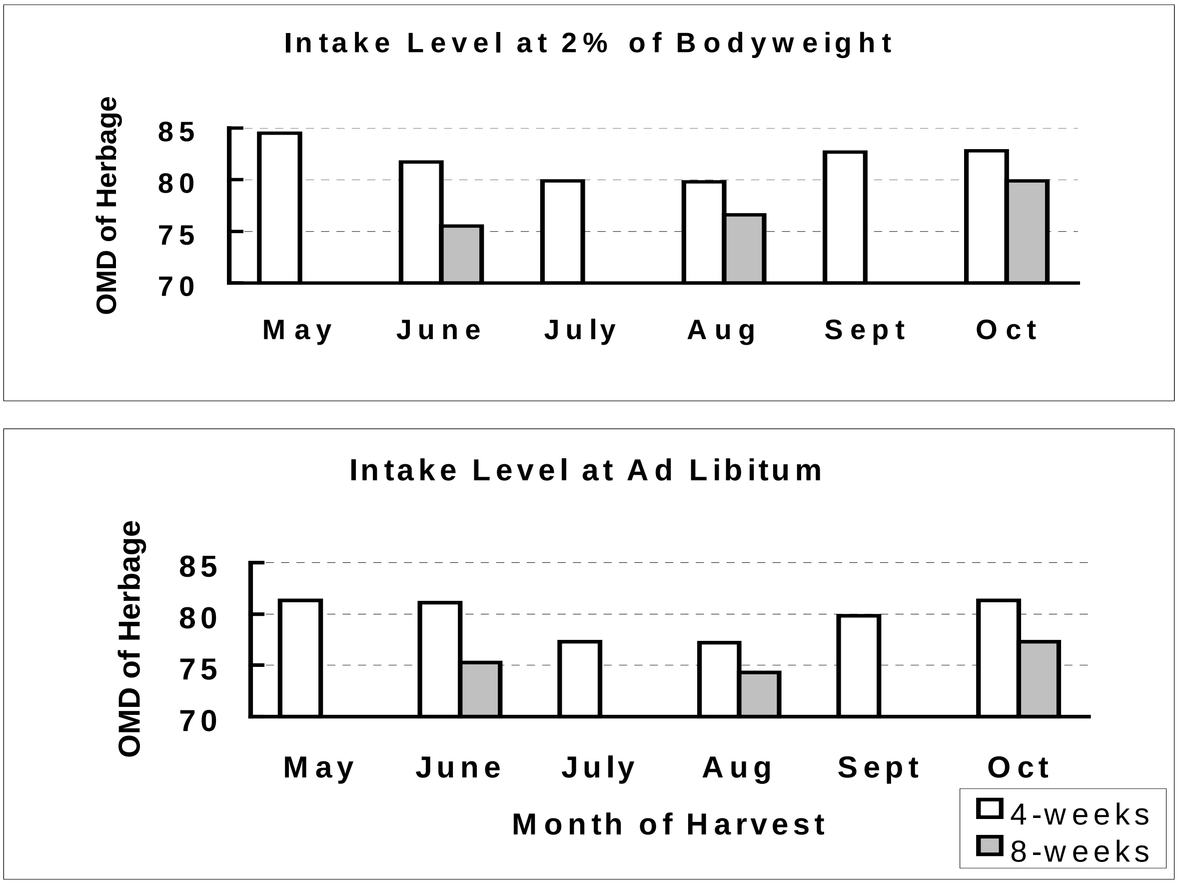
2. Grazing Severity

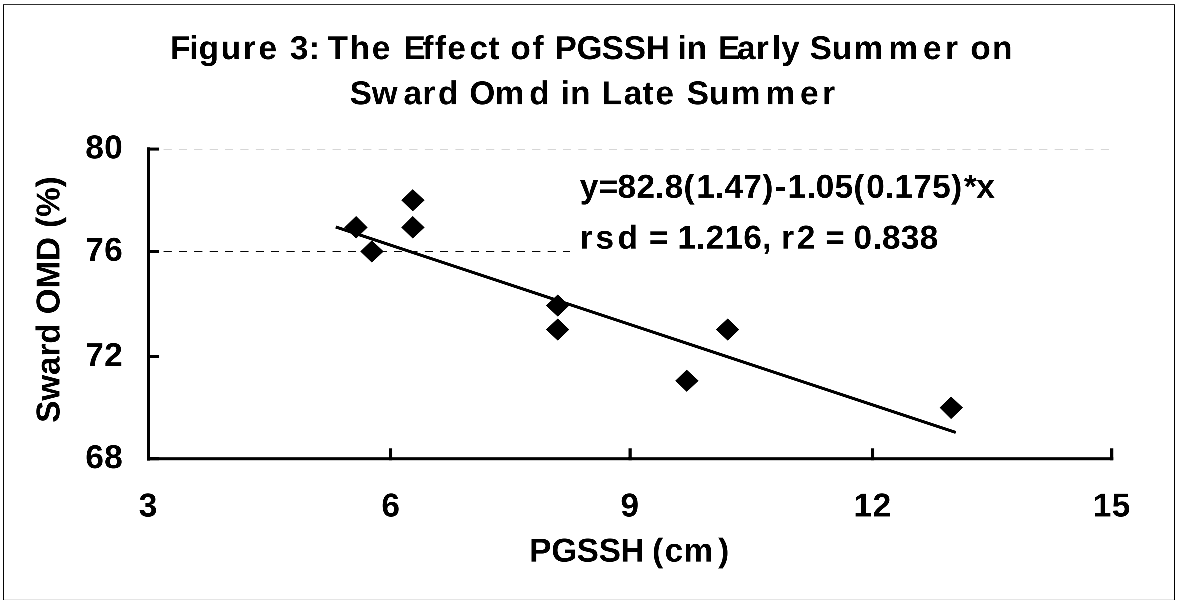
There are two aspects to grazing severity and how it affects sward digestibility. When harvesting is done (either by mechanical means or grazing) to a lower level, there is usually a reduction in the OMD compared to a higher level of harvesting or defoliation. This is because the lower strata of the sward contain much less green grass leaf and more stem and dead material than the upper layers. In grazing, this means that cows will select a diet of lower digestibility when they are forced to graze into the lower layers of the sward. This is more evident from mid-Summer onwards and on lower quality swards. With very high quality (high green leaf content) swards, this is of lesser importance.

The more pronounced effect of grazing severity on sward digestibility is that of the relationship between PGSSH in the late-Spring/early-Summer period and sward structure and digestibility in late summer. A series of grazing experiments in Moorepark in the mid- to late-1980s studied this issue (Stakelum and Dillon, 1990).

Different levels of PGSSH were imposed on ryegrass swards by different grazing pressures with dairy cows in the April to June period. The resultant OMD of the swards throughout the July to October period is shown in Figure 3 based on the respective contribution of the grass in both the tall and short grass areas to the total available yield of grass. The change in OMD for each unit increase in PGSSH was –0.91 (SE: 0.166) and –0.45 (SE = 0.193) for the tall and short grass areas, respectively.

Figure 2 The effect of season and harvest interval on OMD of herbage At two feeding levels to lactating dairy cows





The changes in the tall grass areas dominate. This is because the grass associated with rejected areas or partially grazed areas contribute the bulk of the available grass for grazing in subsequent grazing rotations. For example, with swards grazed to 5.8, 8.1, and 9.7cm PGSSH in the April to June period, the proportion of the total grass available for grazing in those treatments which was associated with the tall or partially rejected areas was 0.53, 0.70, and 0.78, respectively.

3. Lengthening the Grazing Rotation from late-summer

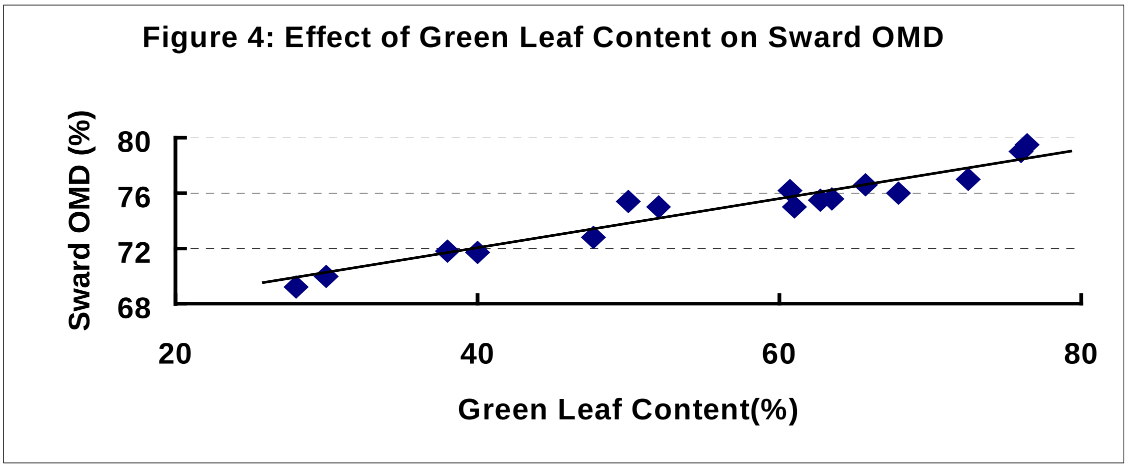
Because of the previously shown smaller effects of a long rest interval on sward OMD from late-summer onwards, interest arose in the question of lengthening the grazing rotation from July onwards with a view to building up farm cover in order to have more grass available for grazing in October and November. There was also the question that having a higher farm cover at this time could increase grass growth rates. A strategy to allow a farm manager to lengthen the rotation from July onwards without unduly depressing the cows' intake by grazing too tight would be to reduce the 2nd-cut silage area and eliminate a 3rd cut of silage in August. Dillon *et al.* (1995) studied the effect of two grazing rotation lengths of 21 and 35 days from the end of June to the end of August at 4.55 and 3.54 cows/ha, respectively. The OMD (%) of the sward was 81.8

and 79.6 (SE = 0.35), modified ADF, 23.0 and 24.1 (g/100g) (SE = 0.30), NDF, 41.9 and 45.2 (g/100g) (SE = 0.56), and live leaf (%) 65.9 and 59.8 (SE = 1.07) for the 21 and 35-day rotations, respectively, during this 8-week period. Daily intake of herbage was not affected. Milk yield levels of 19.2 and 18.2 (kg/cow/day) (SE = 0.27), and a protein content in milk of 3.40 and 3.34 (g/100g) (SE = 0.011) were obtained with the short and long grazing intervals, respectively. It is concluded that there is no advantage in lengthening the rotation by a reduction in stocking rate before early-September.

4. Relationship between Green Leaf Content and Sward Digestibility

The different components in a grazing sward such as grass stem and leaf and live and dead tissue have different digestibility. True stem and dead material have lower digestibility compared to grass leaf. The grass leaf consists of the leaf blade and leaf sheath. The sheaths compose the part of the grass plant known as the pseudostem. Both of these fractions have high digestibility. Figure 4 outlines the relationship between green grass blade and digestibility in mid-Summer swards. The data is taken from a set of Moorepark grazing experiments (Stakelum and Dillon, 1990). It is clear that green leaf content is directly related to digestibility. A 5.5 percentage unit change in leaf content is equal to a 1-unit change in digestibility. A well-managed sward will have very high levels of green leaf in the upper horizons or strata (i.e. above 6 cm) of the sward. The digestibility below this level will be low due to the increasing proportions of dead material and non-leaf fractions. With lenient grazing (above 7 cm PGSSH), this lower strata will exert a larger influence on the sward quality.

Additionally, with a long rest interval, the pseudostems of the grass tillers are allowed excessive time to elongate and the pre-grazing sward canopy becomes too high. In the strata between 4 and 9 cm, elongated pseudostems and developing inflorescent stems predominate. This reduces the digestibility of the overall sward as well as the digestibility within this stratum. This type of sward becomes difficult to graze down.



Effect of Sward Digestibility on Dry Matter Intake and Performance of Dairy Cows

Small changes in sward digestibility are associated with a host of sward structural changes (i.e. the spatial distribution of different morphological sward components in the different strata of the swards), the ratio of tall grass to short grass areas, pre-grazing herbage mass and chemical composition. It is not surprising, therefore, that grazing dairy cows are highly responsive to the digestibility of the swards offered for grazing.

A comprehensive set of grazing experiments were carried out at the Moorepark Center in the '80s to investigate the effect of different sward digestibility levels on dairy cow performance. Different levels of PGSSH created the different levels of digestibility in the April to June period. The swards were evaluated in the late summer to autumn periods using Spring-calving dairy cows. The milk production levels refer, therefore, to the latter half of lactation.

Figure 5 shows the effect of three levels of sward digestibility on milk production, intake, grazing behavior and diet composition. The data is from one experiment to illustrate the processes, which contribute to overall effect on milk yield. Daily milk yields per cow declined by 1 kg and 1.3 kg with the decreasing levels of digestibility. Both intake and diet composition contributed to the differences in milk production.

Daily intake declined by 0.6 and 1.7 kg for each level of digestibility and the diet quality, as evidenced by both digestibility and green grass leaf content, widened as the swards were grazed down. Total grazing time was little different across the different swards. Average biting rate was significantly slower on the poorest quality sward. However, the numerical difference was small.

In another similar experiment, grazing to 6.3, 8.1 and 8.1 cm PGSSH from April to June created three different mid-Summer swards. One of the 8.1 cm grazed swards was mechanically topped to 6.3 cm during this time. The three areas containing the three swards were divided into two areas and Spring-calving dairy cows at either a high or low grazing pressure grazed each. The low grazing pressure was pitched at a level, which would allow adequate grass for grazing, and the high grazing pressure was pitched at a level whereby the PGSSH was 1.5 to 2.0 cm lower than the low grazing pressure. Figure 6 outlines the average daily intakes and milk yields achieved by the grazing cows on the three different swards from July through to October. The mechanically topped sward had an average digestibility of 78%. This was only slightly higher than the digestibility of the sward grazed to the same level. The sward grazed to 8.1 cm had an overall digestibility of 74%.

The mechanically topped sward supported the highest level of milk production at low grazing pressure. At high grazing pressure, both high quality swards supported equal levels of milk production, which were higher than that supported by the low quality sward. It is clear that the two effects of grass digestibility and quantity of available grass were operating in this context. Daily milk yield and intake were very closely related. Over the 6 data points, each extra 1kg of DMI resulted in a 1kg increase in daily milk yield. This is a very significant result. It means that grazing management strategies, which resulted in increased intake, led directly to an increase in daily milk yield even in the second half of lactation. High performance from grazed pasture depends on the digestibility of the sward as well as the amount available for grazing. The response to the higher level of intake of pasture is similar to that which is now obtained from feeding supplementary concentrates at pasture.

Figure 5 Effect of sward OMD on intake, milk yield and ingestive behavior

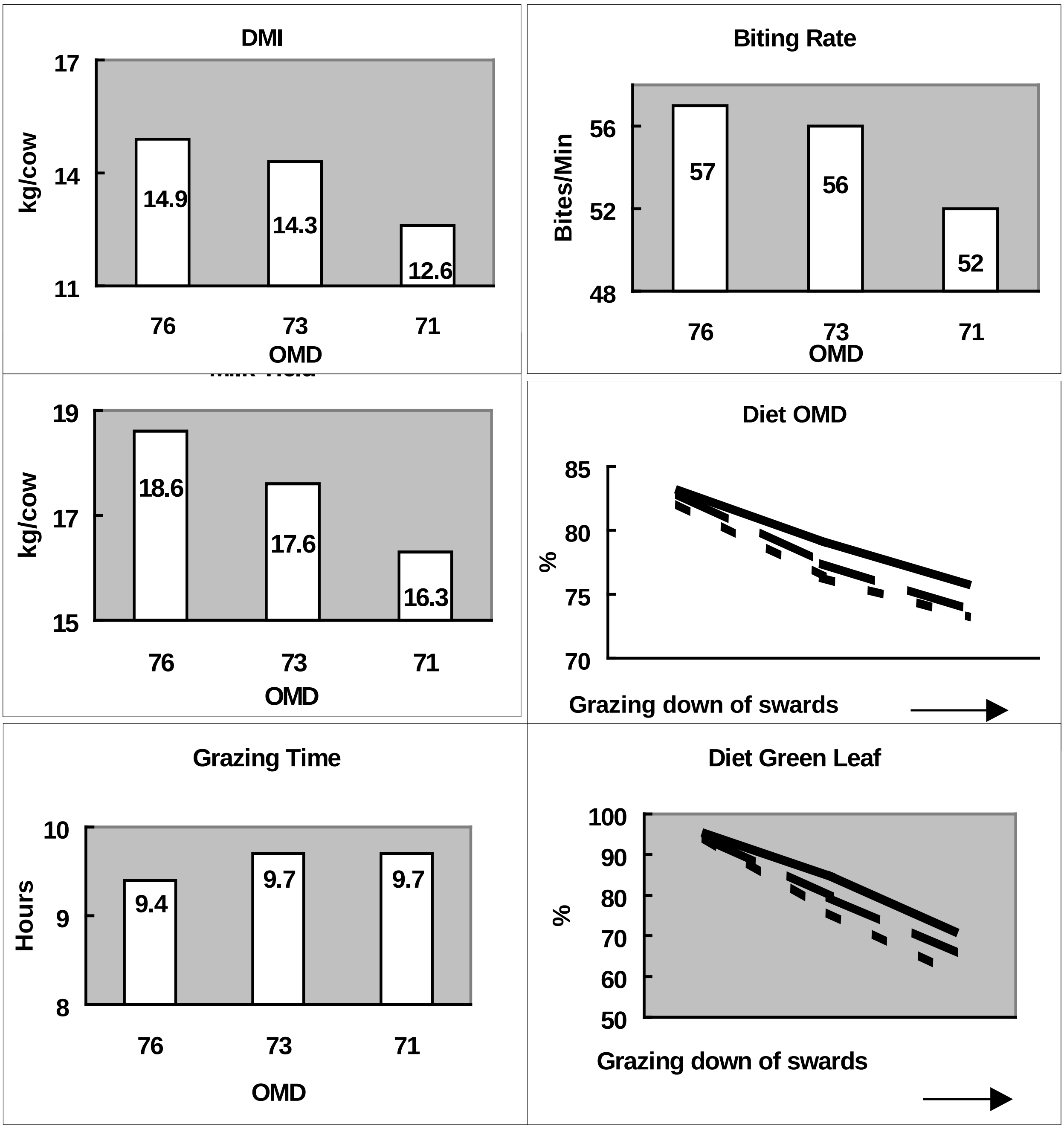
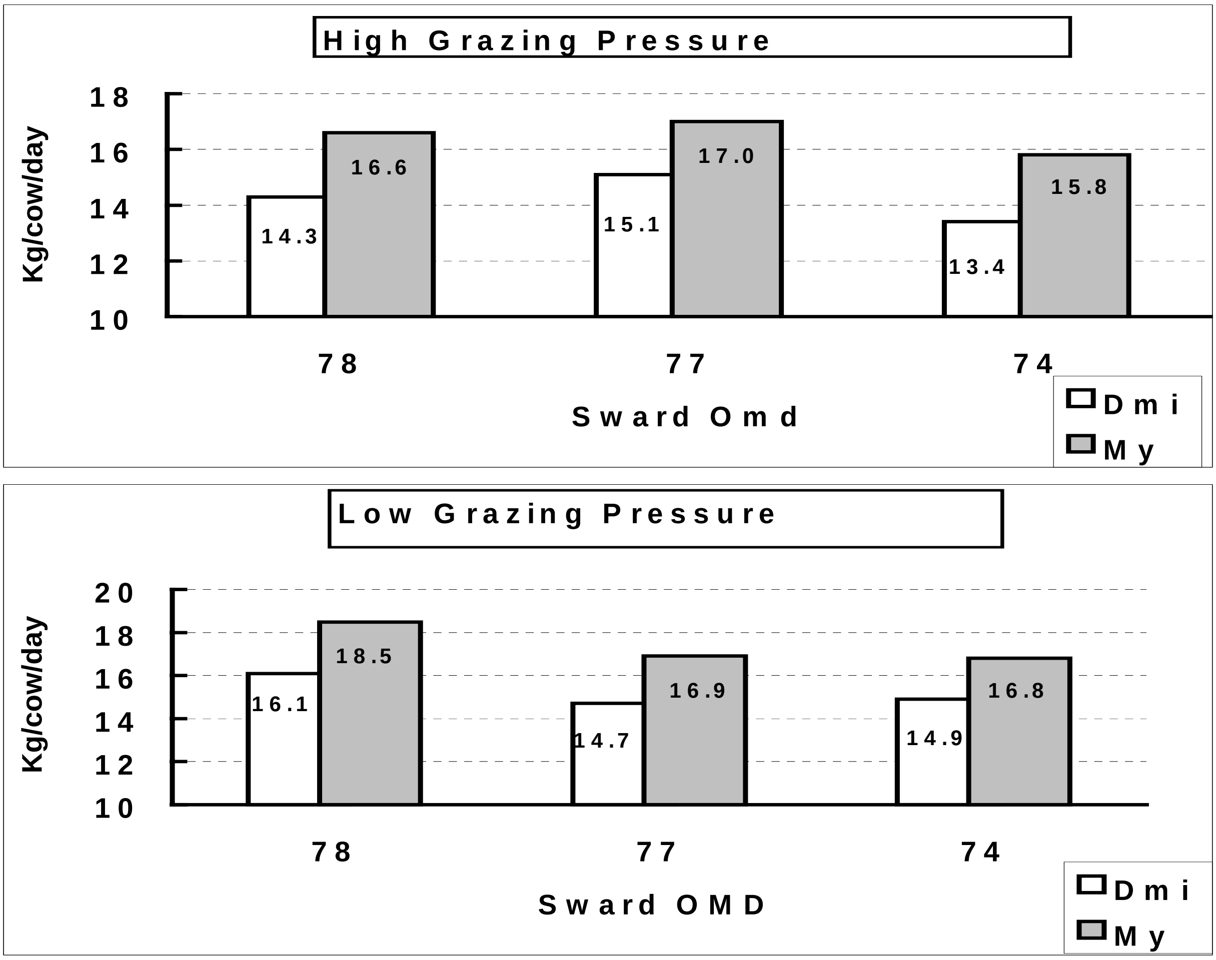


Figure 6   Effect of sward OMD on milk yield and intake at two grazing pressures



Effect of Daily Herbage Allowance (DHA) on intake and performance

A series of experiments have been completed at Moorepark in the recent past, examining the effect of DHA on milk production and intake of both Spring and Autumn-calving dairy cows (Maher, Stakelum, and Rath, 1997 and 1998). The main results are presented in Table 2. In all cases, pasture digestibility was identical across all levels of DHA. In Experiment 1, which was carried out over the summer months, Spring-calving dairy cows of RBI95: 107 and mean calving date of February 19 were used. There was a milk yield response up to the medium level of DHA and a milk protein content response up to the highest level of DHA. Average body weight, bodyweight change and condition score were unaffected by the level of DHA. Average

DMI was 15.3, 16.4 and 17.1 (SED = 0.43) for the low, medium, and high levels of DHA.

In Experiments 2 and 4, which were carried out in the early-summer period (May toJune), both spring-calving (mean calving date of February 18) and Autumn-calving (mean calving date of September 23) cows were used (RBI 95 = 112). The Spring-calvers gave a response in milk yield up to the highest level of DHA (Experiment 2) while the autumn-calvers gave a response up to the medium level of allowance (Experiment 4). There was no effect of DHA on milk protein content in Experiment 2. The effect of DHA on milk protein was significant at the 10% level with the autumn-calving cows in Experiment 4.

In Experiment 3, a similar group of spring-calvers to that used in Experiment 2 were used. This experiment was carried out from late-July to early-September. There was an effect of DHA on milk yield up to the medium level of allowance and on milk protein content up to the highest level of DHA. There was no effect of levels of DHA on bodyweights in Experiments 2 and 4. However, the cows on the lowest level of DHA in Experiment 3 had significantly lower bodyweights than the other groups.
A DHA of 16 kg resulted in a PGSSH of circa. 5 cm or less, while a level of 20 resulted in a PGSSH of between 5.5 – 6.0 cm. The highest level of DHA resulted in a PGSSH between 6.5 and 7.0 cm.

The general conclusions are that dairy cows are more responsive in terms of milk volume in earlier lactation while they are more responsive in milk protein content in later lactation to levels of DHA.

Changes in Daily Herbage Allowance with Changes in Dairy Cow Requirements
Higher yielding dairy cows will require higher levels of pasture intake. Therefore, at the same level of DHA, higher yielding cows are likely to be restricted in terms of intake compared to lower yielding cows. An experiment was carried out to investigate what level of DHA is necessary in order to allow cows with higher intake requirements to achieve this higher intake.

Because of the relationship between DHA and PGSSH, offering higher DHA to herds will result in higher PGSSH. This experiment adopted a novel approach in that it established the DHA that was required by herds of cows of different milk yield potential so that those herds would graze to a PGSSH of 7.0 cm. All 1st parity animals were used. The cows were divided into 4 groups that were identical in all respects except for their current levels of production (Table 3).

Table 2 The effect of daily herbage allowance on daily milk yield (kg/cow/day), milk protein content (%) and PGSSH (cm)

	Allowance				
Expt 1 (May – Aug)	**16**	**20**	**24**	**sed**	
Milk yield	20.6	22.2	22.9	0.48	***
Protein %	3.25	3.28	3.36	0.038	*
PGSSH*	4.4	5.5	6.5	0.12	***
Expt 2 (May – June)	**17**	**20**	**23**	**sed**	
Milk yield	24.4	24.9	26.2	0.46	**
Protein %	3.41	3.46	3.43	0.034	NS
PGSSH*	4.7	5.5	6.6	0.22	***
Expt 3 (Aug)	**16**	**20**	**24**	**sed**	
Milk yield	16.9	18.2	18.3	0.61	*
Protein %	3.47	3.54	3.62	0.039	**
PGSSH*	5.1	5.9	6.7	0.15	***
Expt 4 (May – June)	**17**	**20**	**23**	**sed**	
Milk yield	17.4	18.5	18.8	0.33	***
Protein %	3.73	3.76	3.78	0.21	+
PGSSH*	5.0	6.0	6.9	0.24	***
*PGSSH - Post Grazing Sward Surface Height					

Table 3 The Characteristics of the Cows used in the Experiment

	Yield Category			
	1	**2**	**3**	**4**
Lactation Yield (kg)	4200	5000	5500	6100
Peak yield (kg.day^{-1})	21	25	27	29
Calving day of year	65	57	61	60
Live weight (kg)	510	514	513	524
Length (cm)	121	121	121	123
Height (cm)	134	134	136	136

The groups were grazed separately at whatever DHA, which lead them to graze to the target PGSSH of 7cm. When they reached steady state at this PGSSH, DMI was measured on the individual cows and their ingestive and dietary composition was also measured. The main results are shown in Table 4. The DHA and DMI increased as yield potential increased.

Table 4 The Main Results of the Experiment Comparing the Different Yield Category Cows

	Yield Category			
	1	**2**	**3**	**4**
DHA (kg DM.cow^{-1})	21.2	21.9	22.9	23.9
DMI (kg.day^{-1}.cow^{-1})	14.4	15.4	15.5	16.1
OMD of consumed grass (g.g OM^{-1})	0.846	0.850	0.843	0.845
Live weight gain (kg.day^{-1})	0.13	0.21	0.01	0.01
PGSSH (cm)	6.9	7.0	7.1	6.9
Grazing Residual (kg DM.ha^{-1})	616	619	614	637

The PGSSH and the post-grazing residual yield remained the same for the 4 herds. The herds consumed herbage of equal OMD. The diet was also identical for crude protein (17.8%), ADF (23.8%), NDF (39.3%), ash (8.8%) and water-soluble carbohydrates (14.5%). This was to be expected due to the fact that they were offered identical swards for grazing and grazed the same horizon of those swards. Ingestive behavior (biting rate, daily grazing time, number of grazing bouts and duration of grazing bouts) was similar across the 4 groups. This indicates a faster rate of intake due to increased bite size for the higher yield categories of cows.

The results indicate that optimum DHA for dairy cows under rotational grazing will depend on the DMI requirements of the cows. The practical demonstration of this is shown by the fact that higher merit cows need a lower stocking rate in order to achieve their required intake. Alternatively, high merit animals at a DHA, which would be adequate for lower merit animals (i.e. 18 to 20 kg $DM.day^{-1}$), would require supplementary feed. These results were achieved using all heifers as the experimental animals. Dillon et al. (1999) have shown that, in a systems evaluation of the required DHA for cows (different ages) of different yield potential (Genetic Merit), much higher levels of DHA are needed to achieve the higher intakes of higher merit cows. These results are shown in Table 5.

Table 5 Milk Yield, DHA and DMI in May/June for Cows of Different Potential

	Total Milk Yield (kg)			
	5000	**5800**	**6580**	**7500**
Daily Milk Yield ($kg.cow^{-1}$)	**22**	**25**	**29**	**33**
DHA (kg $DM.cow^{-1}$)	**19.0**	**20.5**	**22.0**	**25.0**
Grass DMI ($kg.cow^{-1}day^{-1}$)	**15.3**	**16.5**	**18.3**	**19.5**

Ryegrass variety effects on cow performance

There is a lot of interest among dairy farmers in newer varieties of ryegrass. These new varieties hold out the possibility of increased annual yield and earlier and higher spring and autumn production as well as higher persistency. Gately et al (1984) examined an early and late heading ryegrass at 2 stocking rates with dairy cows. The results showed advantages to the early variety at high grazing pressure and advantages to the later variety at lower grazing pressure. The main disadvantage with the early variety was the large drop in digestibility in mid-season at low stocking rate. This clearly indicates that different management will be required for different varieties whose growth pattern and growth habit are different. Early heading varieties tend to have a long pseudostem compared to late heading varieties at the same stage of growth. This means that at the same PGSSH of, for example, 6cm, that there would be no leaf below grazing height with the early heading variety. This would depress intake and milk production (Parga, Peyraud and Delagarde, 2000).

At present at Moorepark, 4 ryegrass varieties are being evaluated for milk production. The approach that is being used incorporates the principles of grassland management outlined for the Moorepark blueprint using DHA, PGSSH and farm cover to optimise the system. The varieties under investigation comprise 2 late heading varieties: Millennium (T) and Portstewart (D) which head around June 8, and 2 intermediate heading varieties: Napoleon (T) and Spelga (D) which head around May 22. Table 6 outlines the average daily milk yields of the herds grazing the 4 varieties for the first half of the grazing season (April to mid-July) and afterwards to the end of October). The 2 periods are called P1 and P2, respectively.

Table 6. The Effect of Ryegrass Variety on Daily Milk Yield ($kg.day^{-1}$) for the 1st and 2nd Parts of the Grazing Season

	Ryegrass Variety			
Period	Millennium	Portstewart	Napoleon	Spelga
Year 1 - P1	**24.9**	**25.2**	**23.8**	**24.2**
Year 1 – P2	**18.5**	**17.5**	**17.4**	**17.5**
Year 2 – P1	**24.2**	**25.4**	**23.3**	**23.4**
Year 2 – P2	**19.5**	**19.0**	**17.5**	**17.4**

While these results are preliminary in that the experiment is still in progress, they do confirm the superiority of late heading varieties over earlier heading varieties for grazing dairy cows. Napoleon and Spelga have exceptional spring grass production (especially Napoleon), and major alterations in management are required to control pseudostem elongation and inflorescent development from April to July as well as maintaining farm cover within the optimum range. In the first year there was no great evidence of any quality differences between the varieties but intake in the first period of year 1 was higher for the late varieties as well as OMD of the grass selected by the cows. The results for these parameters are not yet available for the second year. The tetraploids used in this study do not seem to have a whole lot to offer in terms of milk production.

Putting grazing management into practice

The objective in grazing management is to achieve high levels of performance from cows from pasture. The performance is gauged by the production of high levels of milk solids and very good reproductive performance. The positive effect of high performance levels from pasture, on the financial returns from dairying, has been outlined by Dillon and Crosse (1997). This section will cover the practical aspects of rationing grass to the herd over the grazing season in order to achieve a DHA of 20kg DM/cow for average genetic merit cows, and maintain high digestibility levels in the pasture. These objectives are realized by using knowledge of farm cover to ration the available grass. Rationing of grass should not be viewed in a restrictive context i.e. underfeeding the cows and keeping grass in reserve. It should be viewed as allowing cows access to enough pasture. This will result in a high daily intake. It will also achieve a PGSSH of around 6cm. This will maintain high digestibility in the re-growths.

Pasture cover targets

Pasture cover targets (above 4 cm) are now established for systems of milk production based on Spring-calving which will help to achieve high levels of milk production from grazed pasture (O'Donovan, Dillon and Stakelum, 1998). Four critical levels of pasture cover are the closing cover in the autumn/early-winter when the pastures are rested, the opening Spring cover at turn-out, the cover at the end of the first grazing cycle, and cover during the main-grazing season.

Table 7 outlines the targets. These targets have been established from research work at Moorepark and from farm survey data. They are based on growth rates of perennial ryegrass swards under good fertility status, dairy cow requirements, and constraints imposed by the previously described aspects of grass digestibility and PGSSH.

Table 7 Farm cover targets (kg DM/ha) for Summer milk production

Period	Quantity	Remarks
Closing cover	>350	Avoid large covers during last grazing cycle
Opening cover	550-600	Lower covers are possible with lower stocking rates
Cover at end of 1st cycle	750-800	@ 4.5 cows/ha
Cover during main grazing season	900-950	Maintain a 3-week rest-interval

Short-term grass rationing

Day-to-day grazing management is driven by PGSSH, assessment of pre-grazing yields (to achieve an allowance of 20kg DM/cow/day) and ongoing monitoring of daily milk production levels. With compact calving and knowledge of the genetic merit of the herd, a farm manager would, at each stage of lactation or month of the grazing season, know what the potential of the herd is. By this means, given that the herd calved in the correct body condition, any failure of the herd to achieve its potential will be due to the levels of daily intake of nutrients.

PGSSH will inform the farm manager of the levels of DHA and consequently daily intake. A visual appraisal of the pre-grazing yields and its quality is important also. This informs the manager of the quality aspects of grass (amount of green leaf) and the level of grass yield. It is also helpful in farm cover estimation.

The proportion of the grazing area allocated each day for grazing (i.e. the average area grazed per day over a number of days) is an important measure of how much grass is being made available. It is also a continual measure of the grazing rotation speed. It should increase and decrease slightly with variations in the level of pre-grazing grass yield. However, there are limits to the speed with which the rotation length can change because of the effect that too long a rest-interval has on pre-grazing grass yield and quality.

Medium-term grass rationing

The maintenance of farm cover level at around 900-950 kg DM/ha during the main grazing season (mid-April to end of September) requires that action needs to be taken when farm cover departs from this level. When farm cover increases above 1,000 kg DM/ha the surplus grass at a 3-4 week's growth-interval can be harvested as opportunistic wrapped bale silage to bring farm cover back into line. If herd intake of grass is greater than farm grass growth rate, then farm cover will start to decline. Supplementation of the cows with feed or reducing the stocking rate, by inclusion of grazible silage paddocks into the grazing area, needs to be done to prevent the cover dropping below 700 kg DM/ha. This will also help in maintaining the intake of cows over this period.

Farm cover measurement

It is not possible to implement these guidelines without a continuous measure of farm cover. In order to measure farm cover, the farm manager needs to continually calibrate himself/herself on pasture mass estimation. Cutting quadrats of grass weekly/fortnightly (4-6 in number) and measuring the DM yield across a range of grass yields does this. All paddocks in the grazing area need to be walked and a visual assessment of grass yield in each paddock should be done. The data over a number of weeks will show how farm cover pattern is changing and in conjunction with the day-to-day observations on PGSSH and daily milk yields will help the farm manager to maintain the required feeding levels of grass for the herd.

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TRENDS IN GENETIC MERIT FOR MILK PRODUCTION AND REPRODUCTIVE PERFORMANCE

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Introduction

Milk production systems in Ireland are primarily grass-based and involve seasonal calving. A single compact calving system matches grass demand to grass supply. A high pregnancy rate within a short time period following the start of breeding is necessary to achieve a concentrated calving pattern for the following season. The importance of both calving date and the compactness of calving on farm profitability, with both spring and winter milk production systems, has been highlighted previously (Dillon and Crosse, 1994). In a spring milk production system, farm profitability is maximised when calving is concentrated in the months of February/March. In recent years, Irish dairy farmers have expressed concern about the reproductive performance of their herds. Since the mid-1980s the percentage of Holstein-Friesian (North American and European) genetics in the Irish dairy cow population has increased substantially. This has introduced genetics for high productivity (milk yield) into the national cow population. However, it may also have contributed to poorer reproductive performance.

The objective of this paper is (1) to outline national and international trends in milk production and fertility performance, (2) to summarise the results of recent breed/strain comparison studies, and (3) to present the latest results from the large scale "farm fertility study" currently in progress at Moorepark.

Trends in milk production and fertility performance

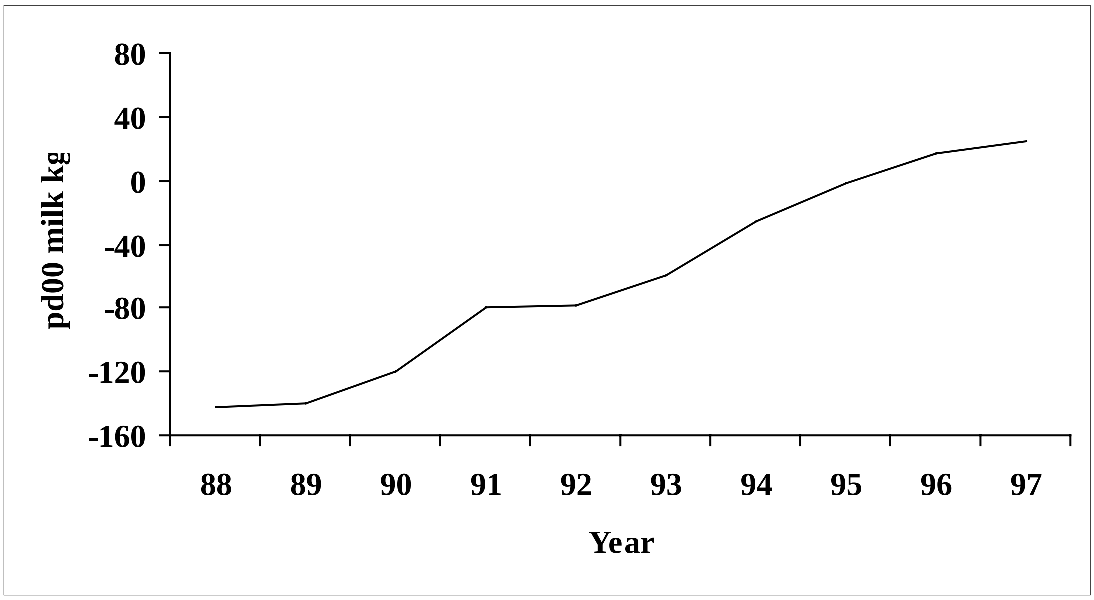
Table 1 shows the change in the proportion of Holstein-Friesian (HF) genetics in cows registered with Holstein UK and Ireland (HUKI) from 1977 to 1995. The proportion of Holstein genetics has increased from < 10% in 1977 to 80% in 1998. Thus in the Irish dairy cow population, breed replacement of Friesian by the North American

Holstein has occurred at a rapid rate since the mid-eighties. Similar trends have occurred in other EU countries e.g. France and the Netherlands. This large increase in HF genetics has been accompanied by a large increase in milk production. Figure 1 shows the increase in the genetic merit (PD00) for milk production of milk recorded cows in Ireland (Irish Cattle Breeding Statistics, 1999).

Table 1. Change in the proportion of Holstein-Friesian (HF) genetics in cows (by year of birth) registered with Holstein UK and Ireland (HUKI) from 1977 to 1995.

Year of birth	Holstein %
1977	< 10
1990	50
1998	80

Figure 1. Change in Predicted difference (00) for milk yield in milk recorded herds in Ireland, 1988-1997.



Source: *(Irish Cattle Breeding Statistics, 1999)*

Table 2 shows phenotypic trends in conception rate to first service over the last twenty years in the USA, UK and Ireland. The results from all three countries show a decline in reproductive performance since the mid-seventies.

Table 2. Phenotypic trends for reproductive performance (conception to 1st service)

COUNTRY	CHANGE/YEAR (%)	PERIOD	REFERENCE
USA	-0.45	1975 to 1997	Beam & Bulter, 1998
UK	-1	1975 to 1998	Royal *et al*., 1999
IRL	-0.9	1989 to 1998	Mee *et al*., 1999

Similar results have been observed in New Zealand (Harris and Kolver, 2000). Increased use of North American Holstein genetics in New Zealand has resulted in, increased milk production and live weight, less efficient conversion of feed into milk solids, and poorer fertility and survival, relative to New Zealand Holstein-Friesian. This has resulted in reduced economic farm surplus in New Zealand dairy farms.

Table 3 shows the milk production and reproductive performance of cows in Moorepark in the mid-1980s (CRT83-85) and early 1990s (CRT90-92). The genetic background of these cows was predominantly British Friesian. At that time conception rates to 1st service of >55% and overall pregnancy rates of >90% were routinely attainable.

Table 3. Milk production and reproductive performance of Friesian cows at Moorepark in the mid-1980s (CRT83-85) and in the early 1990s (CRT90-92).

	CRT83-85	CRT90-92
Milk yield (kg)	5,311	5,633
Milk yield (gal.)	1,135	1,203
Concentrates/cow (kg)	682	295
Submission rate 1st 3 weeks (%)	78	93
Conception rate to 1st service (%)	59	67
Calving to conception interval (days)	87	87
Services/cow	1.64	1.60
Overall pregnancy rate (%)	93	94

Breed/strain comparisons

Moorepark breed/strain comparisons

A number of long-term breed/strain comparisons have been carried out at Moorepark in recent years. The objective of these studies was to compare the biological and economic efficiency of the different genotypes on seasonal grass-based feeding systems. The performance parameters of interest were the milk production, feed efficiency, live weight and condition score and the reproductive performance. Different feeding systems allowed us to test for the existence of genotype x environment interactions. The first study (CRT95-97) was initiated in 1995, comparing high genetic merit (HM) Dutch and French Holstein cows of North American descent to medium genetic merit (MM) Friesian x North American Holstein-Friesian. The proportion of Holstein-Friesian genetics was 92% and 50% for the HM and MM respectively.

Table 4. Milk production and reproductive performance of high genetic merit (HM) and medium genetic merit (MM) Holstein-Friesian cows at Moorepark, 1995 to 1997 (CRT95–97) and 1998 to 2000 (CRT98–00) averaged across feeding systems.

	CRT95-97		CRT98-00	
	HM	MM	HM	MM
Proportion of Holstein (%)	92	50	80	60
Milk yield 2nd lactation (kg)	7,779	6,862	7,841	6,855
Milk yield 2nd lactation (gal.)	1,662	1,466	1,675	1,464
Submission rate 1st 3 weeks (%)	88	93	88	90
Conception rate to 1st service (%)	41	53	49	57
Calving to conception interval (days)	87	89	93	90
Services / cow	2.1	1.8	1.83	1.68
Overall Pregnancy rate (%)	77	94	83	88

Both genetic groups were evaluated under three different grass-based feeding systems. Table 4 shows the milk production (1996) and reproductive performance (1996 and 1997) for both genotypes averaged across the three feeding systems.

Table 5. Milk production and reproductive performance of Holstein-Friesian cows at Moorepark, 1995 to 1997 (CRT95–97) and 1998 to 2000 (CRT98–00) by feeding system (LC – low concentrate, HC – high concentrate), averaged across genetic merit.

	CRT95-97		CRT98-00	
	LC (500kg)	HC (1,000kg)	LC (400kg)	HC (1,500kg)
Milk yield 2nd lactation (kg)	7,087	7,698	6,988	7,856
Milk yield 2nd lactation (gal.)	1,514	1,645	1,493	1,678
Submission rate 1st 3 weeks (%)	92	91	92	85
Conception rate to 1st service (%)	52	48	51	54
Calving to concept. interval (days)	84	90	91	89
Services/cow	1.73	2.05	1.77	1.72
Overall pregnancy rate (%)	89	83	85	84

Table 5 shows the milk production (1996) and reproductive performance (1996 and 1997) for the Moorepark feeding system (500kg concentrates) and the high concentrate feeding system (1,000kg concentrates) in the study CRT95-97 averaged across both genotypes. The results of this study indicate that high genetic merit cows will achieve relatively high levels of milk production on a grass-based feeding system. The study also illustrated that higher grass DM intakes will be achieved during the grazing season provided that stocking rate is adjusted to allow for a higher daily grass allowance. However, the study questioned the suitability of high producing Holstein-Friesian cows for a seasonal system of milk production due to the lower conception rates observed with the HM group relative to their MM counterparts. Increasing concentrate level from ~500 kg/cow to ~1,000 kg/cow over lactation had no effect on conception rates and subsequent overall pregnancy rates.

The second study (CRT98-00) was initiated in 1998 comparing HM and MM Irish Holstein-Friesian dairy cows. The proportion of Holstein-Friesian genetics was 80% and 60% for the HM and MM respectively. Both genetic groups were sourced from Irish dairy farms that had a good breeding program for the previous 10 to 15 years.

Both genotypes were evaluated under three different grass-based feeding systems, 400, 800 and 1,500kg concentrate/cow over lactation. Tables 4 and 5 show the milk production and reproductive performance for the two genotypes average across the three feeding systems and for the high and low concentrate feeding systems averaged across both genotypes. Both genetic groups yielded relative to their genetic potential, but again the fertility performance averaged across the three years of the study was lower than that targeted for an efficient seasonal grass-based system of milk production. Similar to the initial study, increasing the level of concentrates from 400kg/cow to 1,500kg concentrates/cow over lactation had no significant effect on reproductive performance.

From 1996 to 2000, another study carried out at Moorepark compared four breeds of dairy cow i.e. French Montebelliarde (MB), French Normande (NM), Dutch Holstein-Friesian (HF) (100% HF) and home bred Holstein-Friesian (CL) (~60% HF). The four breeds were managed as one group on a spring-calving grass-based system of milk production (~500kg concentrates/cow). The milk yield and reproductive performance of the breeds are shown in Table 6. Milk production was highest for the HF, intermediate for the MB and the CL and lowest for the NB. However, the reproductive performance of both of the Holstein-Friesian groups was substantially poorer than that of the two dual-purpose/French breeds, with the group with the highest proportion of Holstein-Friesian (HF) genes fairing worst.

Table 6. Milk production and reproductive performance of Montebelliarde (MB), Normande (NM), Castlelyons Holstein-Friesian (CL) and Dutch Holstein-Friesian (HF) at Moorepark 1996 – 2000.

	MB	NM	CL	HF
Milk yield 2nd lactation (kg)	5,558	5,106	5,491	6,471
Milk yield 2nd lactation (gal.)	1,187	1,091	1,173	1,382
Submission rate 1st 3 weeks (%)	88	83	84	75
Conception rate to 1st service (%)	50	57	42	37
Calving to conception interval (days)	82	84	89	95
Services/cow	1.82	1.66	2.00	2.05
Overall pregnancy rate (%)	91	91	84	74

Other breed/strain comparison studies

A comparable study at the Scottish Agricultural College in Langhill have investigated the effects of genetic merit and feeding system on silage-based indoor feeding regimes. Table 7 shows the reproductive performance for the selected high merit (S) and the control low merit Holstein-Friesian (C) strains at the SAC Langhill. Similar to previous results at Moorepark the high merit for milk production (S) group had lower reproductive performance and level of concentrate feeding had no effect on reproductive performance.

Table 7. Reproductive performance of selected (S) and control (C) line Holstein-Friesian cows at SAC Langhill.

	Genetic Line		Concentrate level	
	S	C	LC (1,000kg)	HC (2,500kg)
Calving to 1st oestrus (days)	53	42	44	51
Conception rate to 1st service (%)	39	45	41	49
Calving to conception interval (days)	124	107	113	117

Table 8. Comparison of North American Holstein (NAHF) cows and New Zealand Holstein-Friesian (NZHF) cows for milk production, live weight and reproduction traits, expressed as the difference between the NAFH and the NZHF in 1998/1999

Trait	NAHF - NZHF
Milk yield (kg)	+239
Fat yield (kg)	-20.7
Protein yield (kg)	+6.1
Live weight (kg)	+66
Condition score at drying off (0-8)	-0.75
Fat & Protein kg / t DM intake	-3.8
Pregnancy rate (%)	-26.5
Services per conception	+0.7

Source: *(Harris and Kolver, 2000)*

A study has been carried out in New Zealand comparing New Zealand Holstein-Friesian (NZHF) with Dutch Holstein-Friesian cows of North American descent (NAHF) in an intensive New Zealand pasture-based system. Table 8 summarises the results of the last two years of the study. The NAHF cows were heavier, produced a greater milk volume and protein yield, had lower concentrations of fat and protein, were less efficient converters of feed into milk solids (fat & protein), and had poorer fertility and survival than the NZHF cows. Economic analysis indicated that the NZHF had a 12% higher economic farm surplus.

Future Moorepark breed/strain comparisons

Next spring (2001) two further breed/strain comparison studies will begin in Moorepark. One will compare the biological and economic efficiency of New Zealand Holstein-Friesian, high genetic merit Irish Holstein-Friesian of North American decent and medium genetic merit Irish Holstein-Friesian of North American decent. The second study will compare the biological and economic efficiency of Montebelliarde, Montebelliarde x Holstein-Friesian crossbreds, Normande x Holstein-Friesian crossbreds and Norwegian Red dairy cattle.

Farm fertility study – preliminary results

There is considerable evidence in the literature from other countries that selection for milk production may lead to reduced reproductive performance. In recent years there is evidence that this may also be occurring in Ireland. Mee *et al.* (1999) showed that there was a significant decline in calving rate to first service between 1991 and 1998 of 0.9% per year on Irish dairy herds participating in the Moorepark Dairy Management Information System (Dairy MIS).

In 1999 a study was initiated at Moorepark attempting to relate (1) genetic merit for milk production, (2) system of feeding management and (3) health and reproductive management to the reproductive performance on Irish commercial spring calving dairy herds. In other words, the study is an attempt to identify the major factors causing differences in reproductive performance between cows and between herds. The study involved a total of 73 herds with fertility performance from 6,399 cows in 1999 and a similar number in 2000.

Detailed individual cow records were collected throughout 1999 and 2000. The measurements included:

- Milk production performance (A4 milk recording).
- Live weight and condition score (8-9 occasions throughout the year).
- Fertility performance recorded using Dairy MIS II.
- Detailed pre-breeding ultrasonography to determine ovarian cyclicity and uterine condition.
- Feeding and management practices were recorded on each farm using Dairy MIS II.
- Type classification - by HUKI - all first lactation animals.
- Blood metabolites and trace element status (a proportion of cows in each herd during the first 3 weeks of the breeding season).

The main results from 1999 are summarised as follows:

Fertility and preventative herd health management practices

Of the participating farms, 93% and 54% practised vaccination for leptospirosis and salmonellosis, respectively. Almost all farmers (96%) supplemented with dry cow minerals. Pre-breeding oestrus detection was carried out on 88% of the farms. 92% of farmers observed cows > 2 times daily during the breeding season, while 99% of farmers used tail paint ± vasectomised bull as an aid to heat detection. Artificial insemination (AI) was carried out by DIY in 62% of herds, while 78% of farms used a stock bull as part of the breeding programme.

Production performance

Table 9 shows the variation in milk production and concentrate usage for the farms on the study in 1999. The average milk production per cow was 1,240 gal/cow with a range of 1,054 to 1,569. Concentrate supplementation levels per cow averaged 745 kg with a range from 335 to 1,305 kg/cow for individual farms.

Table 9. Milk production and concentrate usage for the herds on the Moorepark Farm Fertility study in 1999

	Mean	Min.	Max.
Milk yield (kg)	5,804	4,934	7,344
Milk yield (gal.)	1,240	1,054	1,569
Fat + protein (kg)	416	353	531
Fat (%)	3.84	3.54	4.05
Protein (%)	3.33	3.17	3.50
Concentrates fed (kg/cow)	745	335	1,305

Reproductive performance

Submission rate (SR)

While the average SR achieved is low (70%), relative to the target value of 80% (Table 2), the wide variation among herds (33-96%) suggests higher values are achievable. A high SR is critically dependent upon the previous years calving pattern, efficiency of pre-breeding season and breeding season heat detection and prevalence of ‘anoestrus’ cows.

Table 10: Reproductive performance of the herds on the Moorepark study 1999

	All herds	Top 25%	Target
Pregnancy rate to 1st service (%)	48	59	>60
Submission rate (SR) (%)	70	88	>80
Services/conception (no.)	2.1	1.7	<1.65
Calving to 1st service interval (CSI) (days)	72	66	≤70
Calving to conception interval (CCI) (days)	89	82	≤85
Non-detected oestrus (%)	15	5	<10
Infertile rate (%)	14	8	<10
Weeks breeding	15	11	13

Pregnancy rate (PR)

The first service PR reported here (Table 10) of 48% is well below the target value (60%). The variation between herds (26 to 73%) for PR to first service also suggests that higher levels are achievable. A comparison of the top and bottom quartile of herds on PR to first service showed that second service was also higher in the top 25% of herds, while services per conception, calving to conception interval, non-detected oestrus, infertile rate and length of the breeding season were lower. The calving to service interval was similar.

Calving to service and conception

In order to maintain a 365-day calving interval, the optimum calving interval in seasonally calving herds, cows need to be served within 60 to 80 days of calving and conceive within 80 to 85 days of calving. Unlike indices such as PR, the farmer decides the voluntary waiting period after calving, hence the calving to first service interval (CSI) is highly dependant upon management breeding policy. The calving to conception interval (CCI) is determined by the CSI and the conception rate. In the present study, the CSI ranged from 59 to 91 days. On average, across all herds the CSI was within target, although the CCI at 89 days was indicative of a 4-day slip in mean calving date.

Infertile rate, no. of services and length of the breeding season

While in the top quartile of herds only 8% of cows were empty at the end of the breeding season, those in the lower quartile had on average 22% of cows not pregnant. It must be borne in mind that the variation in this parameter is not only dependent on SR and PR etc. but also on the duration of the breeding season. A longer breeding season allows more services per cow and thus a greater chance of conceiving. The average number of services received per cow on the study was 2.1. The length of the breeding ranged from 9 to 25 weeks across individual herds.

Pre-breeding ultrasonography

Three quarters (73.7%) of all cows had normal uterine involution by the start of the breeding season. However 16% of cows were not cycling regularly at the start of mating. In the majority of cases (10.3%) the cows had not yet begun to cycle after calving. In a minority of cases the cows were cystic (3.1%) or had pyometra (2.2%). Uterine infection/inflammation/delayed involution was detected in a quarter (26.3%) of cows based on scanning and palpation of the tract. The majority (20.3%), however were mild cases, the relevance of which has not yet been determined. Pyometra, on the other hand, is a definite risk factor for conception failure and although over all it was uncommon (2.2%), the high incidence in some herds (7.8%) warrants further investigation.

Blood biochemistry and trace elements

In general the energy status of the first lactation animals was normal as assessed by blood beta-hydroxybutyrate (ßHB), non-esterified fatty acid (NEFA) and glucose concentrations. This is perhaps not surprising given that the samples were taken during the first three weeks of the breeding season, on average >70 days post-calving when cows would be expected to be in a positive energy balance. The protein status of the first lactation animals was on average normal as indicated by blood total protein (TP) and blood urea. Both the copper and selenium levels of the mature cows were normal. This may be explained by the location and soil types of the farms, the inclusion of trace elements in the diet of the lactating cow or a carry-over effect from such supplementation. The wide variation in herd iodine status is due to supplementation with iodine containing concentrates during the breeding season in some herds and herbage iodine levels. Blood iodine levels do not reflect long-term iodine supplementation, but rather, intake in the hours and days preceding blood sampling.

Genetic parameter estimation

Large differences within traits measured were observed between groups of daughters of individual bulls. For example, among the ten most popular bulls (with between 52 and 237 daughters per bull), the daughters of the highest yielding sire averaged 25.6 kg milk per day whereas the lowest yielding sire yielded 20.5 kg per day. Similarly, daughters of the highest and lowest sire condition score were 2.99 and 2.74, for live weight 601 and 481kg, and for pregnancy rate 0.95 and 0.83. Hence there were large sire effects in the data. However, some of the sires had first lactation daughters only, whereas others had daughters in later lactations only. To adjust for these effects, genetic parameters need to be estimated. Genetic parameter estimation is instrumental for the development of a new RBI index that includes fertility information also.

Heritability

The observed performance of an animal (its phenotypic value) for any given trait is a function of its genetic value for that trait together with the environmental effects. The heritability (h^2) value for a trait is the contribution of the genetic variation as a proportion of the total phenotypic variation for the trait. Heritability values range from 0 to 1. The higher the h^2 for a trait, the easier it is to select genetically superior animals for that trait, because more of the differences between animals are due to their genetic background. The h^2 estimates for a range of performance traits measured in the Moorepark study are shown in Table 11. The h^2 estimates are very similar to that published previously (Veerkamp and Brotherstone, 1997). The h^2 estimates for milk yield traits varied from 0.25 to 0.40. The h^2 estimates for live weight and condition score varied from 0.38 to 0.47. As expected, the h^2 estimate for the pregnancy rate traits were low at 0.01 and 0.02 for 6-week in-calf rate and 9-week in-calf rate into the breeding season respectively. Relatively higher h^2 estimates were observed for calving to 1st service interval and start of breeding to 1st service interval at 0.06 and 0.06 respectively.

Table 11: Heritabilities (h^2) for performance traits during the first 150 days of lactation, (Moorepark farm fertility study, 1999).

Trait	h^2
Daily milk yield	0.25
Daily fat yield	0.40
Daily protein yield	0.28
Average live weight	0.51
Average condition score	0.35
Calving to 1st service interval	0.06
Start of breeding to 1st service interval	0.06
6-week in-calf rate	0.01
9-week in-calf rate	0.02

Daily milk yield and associated parameters comprised of the average of at least 3 tests within 200 days post-calving, Live weight and condition score were calculated as the average between day 60 and day 100 post-calving. Pregnancy was determined by rectal palpation in late autumn.

Genetic correlation

Although the h^2 estimate for pregnancy rate is low there is considerable genetic variation within the trait. In recent years there has been great interest in traits that may help predict fertility traits. A genetic correlation illustrates the correlation between the breeding values for two traits. As shown in Table 12, and as expected the genetic correlation between milk yield and yields of milk solids is high. Preliminary results indicate that high milk yield is positively correlated with high live weight and both of these traits are negatively correlated with pregnancy rate. As milk yield increases condition score decreases. As milk yield increases mean condition score decreases, and mean condition score in turn is negatively correlated with pregnancy rate.

Table 12: Genetic correlations between some performance traits measured during the first 200 days of lactation (Moorepark farm fertility study, 1999)

Traits	***Genetic correlation***
Yield * fat yield	0.27
Yield * protein yield	0.71
Yield * mean live weight	0.42
Yield * mean condition score	-0.34
Yield * preg. rate (6-week)	-0.77
Yield * preg. rate (9-week)	+0.16
Yield * calving to 1st service interval	-0.11
Yield * start of breeding to 1st service interval	-0.08
Live weight * overall preg. rate	-0.40
Mean condition score * overall preg. rate	+0.44

Second trait on first trait, e.g. fat yield on yield.

The preliminary results suggest that both live weight and condition score might be important traits in the selection process for improved reproductive performance because both have high h^2 and are strongly correlated with pregnancy rate. However further analysis is required to find those traits that best identify cows with a high yield, without a penalty for reproductive performance.

The 1999 data set had ~5,500 cows for the various traits investigated. In order to strengthen the reliability of the h^2 and genetic correlation estimates, the data from 2000 will be added.

Conclusions and implications

The information presented indicates that fertility performance in Irish dairy herds has decreased rapidly in recent years. In Ireland, the dairy herd is under going breed substitution at an increasing rate, from a herd predominantly of British-Friesian makeup to North American Holstein-Friesian. Although the Holstein-Friesian has superior genetic merit for milk yield, it may also carry the undesirable genes for sub-fertility (Darwash *et al*., 1999). Increased proportion of Holstein-Friesian in the Dutch dairy population has resulted in reduced reproductive performance (Hoekstra *et al*., 1994). Until very recently the North American Holstein-Friesian has been selected exclusively for milk volume in an environment where reproductive performance has a much lower significance than it has in a seasonal system of milk production. It has been postulated that artificial selection for a particular trait may lead to the situation in which the resources of the animal are used to the maximum to support that trait, thus, no buffer is left to respond adequately to unexpected stresses and challenges. Preferential allocation of resources may occur because the animal may be 'genetically pre-programmed' to allocate a disproportionately large amount of resources to the trait selected for, leaving the animal lacking in ability to respond to other demands (Dunnington *et al*., 1990). Economic analysis at Moorepark shows that the advantage of increased milk yield may be totally eroded by the problem of poor reproductive performance (Dillon and Buckley, 1999).

Genetic improvement of fertility is of economic importance for the Irish dairy industry. The reason being that milk production systems in Ireland are to a large extent based on seasonal calving pasture based systems, where breeding and calving is restricted to a very limited period of the year. To halt or at least slow down this rate of decline in reproductive performance, fertility traits should be included as part of the breeding goals or selection objectives. Selection indices have been used in many countries to combine traits of economic and biological importance. A new selection index, taking into account traits such as calving interval and survival as well as production traits will soon be announced by ICBF. Initial results from the Moorepark farm fertility study show heritability (h^2) estimates of traits calculated using service data are low, (0.01 to 0.05). There is evidence however, that large differences do exist between daughters of bulls for fertility traits. To obtain accurate breeding value estimates large progeny groups will be required. For example when the (h^2) is assumed to be 0.03, a progeny group size of 200 would be required to give reliability of 85%. In the future the level of milk recording will have to increase from the present level of 23% (1999) to facilitate greater sire testing. Initial results from the farm fertility study indicate that condition score has both a high h^2 (0.4 to 0.5) and a strong correlation with pregnancy rate (0.4 to 0.6). A selection index could include condition score to augment existing calving interval data.

In the short term however, farmers must select bulls whose daughters have already above average figures for reproductive efficiency/survivability in their country of origin.

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WINTER FEEDING FOR SPRING AND AUTUMN HERDS

Dr. Siobhán Kavanagh, Dr. John Murphy

A new system of evaluating feedstuffs

As production levels increase, so too does the importance of a diet that is correctly balanced for energy, protein, minerals and vitamins. Currently, University College Dublin and Teagasc are developing a revised feeding system in co-operation with the animal feed industry in Ireland and INRA in France. This feeding system is sub-divided into energy, protein and intake sub-systems.

Given the complexity of the systems when formulating diets, the three sub-systems above (energy, protein and intake) have been incorporated into a computer program called INRAtion. There is a comprehensive database of Irish forages and concentrate ingredients in the program. Silage analysis and ingredients for individual farms can be loaded into the system, allowing the formulation of diets specific to the quality of the forage and ingredients available on a particular farm.

Animal categories available in the program include dairy cows (early and mid-lactation), beef animals (growing and finishing), suckler cows and sheep. Within each category, details need to be supplied on performance criteria including milk yield and composition for lactating cows, breed and daily gain of beef animals, stage of pregnancy and condition score in sheep. The quality and quantity of concentrate required to supplement a specific forage, for a particular level of performance, is predicted.

Energy

Traditionally diets have been formulated to metabolisable energy (ME) but this system overvalues the energy value of poor quality feeds relative to good quality feeds. For this reason a net energy (NE) system is being adopted which will allow better comparisons between the nutritional value of feedstuffs. The NE value of feedstuffs is expressed in terms of FEED UNITS (UF). The system applies two NE values to feedstuffs: (I) UFL for lactating dairy cows, growing beef cattle and sheep and (2) UFV for finishing cattle. In most situations (dairy, beef and sheep) UFL values are used, apart from situations where high levels of concentrates (80% +) are being offered or growth rates over 1.0 kg per day are being achieved. In this situation the UFV value is used.

Barley is the standard feed in this system and all other feeds are given values relative to barley. Standard barley has a net energy value of 1 UFL or 1 UFV per kg as fed. The lower the UFL or UFV value the poorer the energy value of the feed. The NE value of feedstuffs range from 0.45 UFL / kg as fed for good quality straw to 1.05 / kg as fed for maize grain. The UFL value of grass silage (70% DMD) is 0.78 / kg dry matter and that of maize silage (25% starch) is 0.80 / kg dry matter.

Table 1 presents the energy requirements and diet supply of a cow (producing 28 kg milk per day, 3.6% fat & 3.2% protein). Energy requirements calculated from the combined maintenance requirement (5 UFL) and the requirement for milk (11.6 UFL), amount to 16.6 UFL. The energy supplied by the diet is calculated from the dry matter intake of forage (11 kg DM) and concentrate (7 kg DM) and the energy value of the grass silage (0.78 UFL) and concentrate (1.05 UFL). The total energy supplied by the diet is 15.4 UFL. There is a deficit of 1.2 UFL (16.6 – 15.4 UFL), therefore the cow must loose 0.3-0.4 kg live weight to maintain production (28 kg milk/day).

Table 1. Calculating energy requirements and diet supply for a dairy cow producing 28 kg (6 gal) of milk per day containing 3.6% fat and 3.2% protein

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Energy requirements of cow
Maintenance = 5 UFL
Milk production = 11.6 UFL

Total = 5 + 11.6 = 16.6 UFL

The Diet	Energy Supply
Grass silage (11 kg DM)	11 * energy content of grass silage (0.78 UFL) = 11 * 0.78 = 8.6 UFL
Concentrate (7 kg DM)	7 * energy content of concentrate (1.05 UFL) = 6.5 * 1.05 = 6.8 UFL
	Total = 8.6 + 6.8 = 15.4 UFL

Energy requirement of cow = 16.6 UFL
Energy supply of diet = 15.4 UFL

There is a deficit of energy (1.2 UFL) & the cow must loose 0.3 – 0.4 kg live weight to make up the difference

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Protein

Protein is made up of building blocks called amino acids. The true protein value of any feedstuff is best measured by the quantity of these amino acids that are absorbed by the animal, not what the animal consumes. The amino acids that are absorbed by the animal come from two sources: (1) bacteria in the rumen (first stomach) of the cow, which converts energy and nitrogen into bacterial protein (bacterial amino acids) and (2) undegradable protein in the feed, which is not changed in the rumen. The quantity of bacterial amino acids made by the bacteria in the stomach is reliant on a supply of nitrogen and energy. There are potentially two amounts of bacterial protein that the cow can generate – one that relies on there being enough nitrogen in the rumen and one that relies on there being enough energy in the rumen. If there is a limited supply of nitrogen the protein value is called PDIN. If there is a limited supply of energy the protein value is called PDIE. Each feed has two values (PDIN and PDIE).

The lower of the two values is the actual protein value of the feed. Typical protein values of Irish feedstuffs are presented in Table 2. Feeds that are high in crude protein tend also to be high in PDIN. Usually in grass silage based diets there is not enough energy to convert all the nitrogen in the diet into bacterial protein. Therefore, the energy supply is limiting and the protein value of grass silage is normally as PDIE.

Table 2. Protein value of Irish Feedstuffs

	Crude Protein, g/kg*	***PDIN, g/kg***	***PDIE, g/kg***
Barley	***98***	***64***	***89***
Unmolassed beet pulp	***88***	***56***	***97***
Maize gluten	***203***	***137***	***108***
Soyabean meal	***481***	***342***	***232***
Grass silage	***15***	***82***	***70***
Maize silage	***85***	***50***	***68***

*Crude protein g/kg = crude protein % * 10

In Table 3 the protein supply from a diet of grass silage and concentrates is calculated. The two protein values for grass silage are 85 g PDIN and 72 g PDIE. The two protein values for the concentrate are 140 g PDIN and 120 g PDIE. The total intake of the diet is 11 kg DM silage and 7 kg DM concentrate. The total protein supply in the diet is 1915 g PDIN (85 * 11 + 140 * 7) and 1632 g PDIE (72 * 11 + 120 * 7). This means that there is enough nitrogen in the feed to produce 1873 g amino acids but only enough energy to produce 1632 g amino acids. Therefore the true protein value of this diet is 1632 g amino acids. Always the PDIN and PDIE from the components of the diet are summed separately and the lower of the two values is the protein supply from the diet. Generally when grass silage is the sole forage the PDIE value is the lowest.

Table 3 Calculating PDI supply in the diet

	PDIN, g	PDIE, g
Grass silage	85	72
Concentrate	140	120
Silage intake (11 kg DM)		
Protein supply from silage	11 * 85 = 935	11 * 72 = 792
Concentrate intake (7 kg DM)		
Protein supply from concentrate	7 * 140 = 980	7 * 120 = 840
Total protein supply	935 + 980 = 1915	792 + 840 = **1632**

Intake

An estimate of potential intake is essential if the supply of energy and protein from a diet is to be calculated. In most situations the aim in the formulation of complete diets for ruminants is to maximise forage intake and use concentrates to balance animal requirements. One of the advantages of the French system is that forage intake is calculated and from that concentrates are substituted-in to meet animal nutrient requirements. The French intake system (Fill Unit System) integrates information on the potential intake of an animal at any one time (cow intake capacity) and the quality of the forage. For example, the system will distinguish between a dairy cow in early lactation, at less than peak intake and in mid lactation, at peak intake.

Intake values are assigned to forages, relative to the quality of the forage and its potential intake. Three intake values are assigned to each forage - one for sheep (SFU), cattle (CFU) and lactating cows (LFU). Grazed grass is the standard forage and all other forages are given intake values relative to this. Standard grazed grass has an intake value of 1.00. The higher the intake value, the lower the potential intake of the forage. Grass silage (72% DMD) has an intake value of 1.31 LFU and maize silage has an intake value of 1.13 LFU. In Table 4 the predicted dry matter intake (as the sole feed) of these forages has been calculated. As the fill value (LFU) of the forage increases the potential intake of the forage decreases.

Table 4. Intake values for forages

Forage	Intake Value (LFU)	Potential Intake of forage as the sole feed, kg DM*
Grazed grass	1.00	17.2
Maize silage	1.13	15.2
Grass silage (72 DMD%)	1.31	13.1

* Dairy cow producing 28 kg (6 gal) of milk per day containing 3.6% fat and 3.2% protein

The system calculates potential intake of the cow as presented in Table 5. The grass silage has a DMD of 72% and an intake value of 1.31 LFU. The maximum intake capacity of the cow is 17.2 LFU. By dividing one by the other the intake of silage as the sole feed is 13.1 kg DM. But silage is not consumed as a sole feed by milking cows. INRAtion calculates a requirement for 7 kg of concentrate dry matter and for each kg of concentrate added, silage intake decreases by 0.3 kg.

Table 5. Calculating potential intake using this system

Intake value of grass silage (72% DMD)	1.31 LFU
Cow intake capacity	17.2 LFU
Intake of silage as the sole feed	17.2 / 1.31 = 13.1 kg DM
Concentrate intake	7 kg DM
Intake of silage with concentrate = 13.1 – (7 * 0.3) = 11 kg DM	
Total intake (silage + concentrate)	11 + 7 = 18 kg DM

Supplementing forage based diets

Suggested supplementation rates

Early lactation (weeks 0-12) is a critical period in the nutrition of the cow. Milk yield in dairy cows peaks ahead of intake, which leads to an imbalance between the energy requirements of the cow and energy supplied by the diet. Early lactation feeding is focused on avoiding excessive body weight loss while maintaining milk production levels. Body weight loss of up to 0.5 kg per day, for the first 8 weeks of lactation, is acceptable. Table 6 shows the recommended concentrate feeding levels for herd yields up to 1300 gals per lactation, when grass silage is the main forage. Supplementation should increase by 2 to 3 kg per day with high yielding cows (1400 to 1700 gals).

Supplementation rates where maize silage constitutes 2/3 of the forage proportion of the diet may be reduced by 2-2.5 kg, from the recommendations in Table 6.

Table 6. Recommended supplementation rates for grass silage based diets*, according to silage DMD %

Silage DMD (%)	Supplementation (kg/cow/day)
75	6
70	7
65	8
60	9

*Cow producing 28 kg milk

Suggested concentrates for balancing forages

Balancing grass silage

Supplements for grass silage based diets should contain a minimum of 0.94 UFL and a crude protein of 180 – 200 g/kg (PDI = 105 g/kg). Two concentrates are presented in Table 7 for grass silage based diets. Option 1 is formulated with a limited range of ingredients and Option 2, which is more complex with a greater range of ingredients. The nutritional value of both these concentrates is similar and expected performance would be similar on both concentrates.

Table 7. Concentrates to balance grass silage based diets

Option 1		Option 2	
Ingredient	*%*	*Ingredient*	*%*
Maize gluten feed	30	Distillers grains	20
Maize distillers	26	Soyabean meal	15.5
Barley	35	Unmolassed beet pulp	15
Rapeseed meal	6.5	Citrus pulp	15
Mineral / vitamin mix	2.5	Barley	13.5
		Soya hulls	7.5
		Palm kernel meal	6
		Molasses	5
		Mineral / vitamin mix	2.5
Analysis		*Analysis*	
UFL	0.95	UFL	0.95
UFV	0.92	UFV	0.93
PDIN	124	PDIN	125
PDIE	105	PDIE	116
Crude protein, g/kg	186	Crude protein, g/kg	182

Balancing maize silage

Maize silage is an alternative forage with good intake characteristics which can partially replace grass silage and increase total forage intake. With maize silage based diets a concentrate containing a high level of crude protein (240-280 g/kg) is necessary to balance the low level of crude protein (100-120 g/kg DM) in maize silage. The optimum level of crude protein in the concentrate will depend on the level of feeding. Results at Moorepark indicate a level of 250 g crude protein / kg fresh weight in the concentrate is about right for mixed forages containing maize silage when supplemented with concentrate at a level of 6 kg/cow/day. At lower levels of supplementary feeding the level of crude protein in the concentrate may need to be increased. Table 8 presents 2 concentrates to balance a diet where maize silage constitutes 2/3 of the forage proportion of the diet. Both concentrates contain similar levels of energy (0.94 – 0.95 UFL) and crude protein (28%). These concentrates might be suitable for lower feeding levels than suggested above. In both options ingredient composition is quite different but the nutritional value of both is similar.

Table 8. Concentrates to balance maize silage based diets

Option 1		*Option 2*	
Ingredient	*%*	*Ingredient*	*%*
Soyabean meal	27	Soyabean meal	30
Maize gluten feed	20	Distillers grains	30
Unmolassed beet pulp	17	Maize gluten feed	11.5
Rapeseed meal	17	Soya hulls	10
Distillers grains	16.5	Unmolassed beet pulp	7
Mineral / vitamin mix 2.5		Sunflower meal	6
		Molasses	3
		Mineral / vitamin mix	2.5
UFL	0.95	UFL	0.94
UFV	0.91	UFV	0.91
PDIN	195	PDIN	195
PDIE	142	PDIE	142
Crude protein, g/kg	286	Crude protein, g/kg	284

Quota restricted situations

In a quota restricted situation where less than optimum yields may be desirable, lower protein concentrates may be used. Table 9 presents two such concentrates to balance grass silage based diets. Generally such concentrates would be offered at about 5 kg per cow per day in early lactation.

Table 9. Suggested concentrates to balance grass silage in the quota situation

Option 1		Option 2	
Ingredient		*Ingredient*	
Maize gluten feed	30	Distillers grains	23.5
Unmolassed beet pulp	30	Citrus pulp	20
Barley	22.5	Maize gluten feed	15
Distillers grains	15	Unmolassed beet pulp	14
Mineral / vitamin mix	2.5	Palm kernel meal	10
		Soya hulls	10
		Molasses	8
Analysis		*Analysis*	
UFL	0.95	UFL	0.94
UFV	0.91	UFV	0.88
PDIN	99	PDIN	98
PDIE	99	PDIE	99
Crude protein, g/kg	149	Crude protein, g/kg	145

Recent research on transition period feeding

Introduction

The period of time during which a cow progresses from gestation to lactation has, in recent times, received considerable interest from a nutritional standpoint. This period has become known as the Transition Period, and is generally accepted as extending from about three weeks before calving until three weeks after calving. The pre-calving period is referred to in the US as the close-up dry period. A gradual decline in dry matter intake commences three weeks before calving, accelerating rapidly in the last few days before calving. This can be clearly seen in data from Moorepark as illustrated in Figure 1.

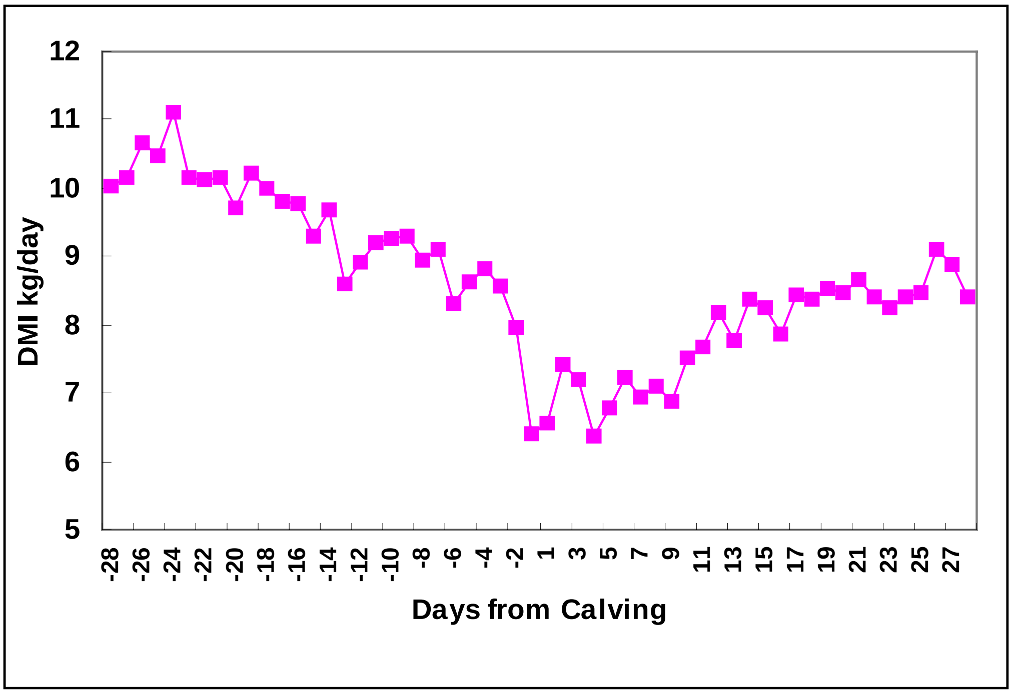

Figure 1. The pattern of daily silage DMI from 28 days pre-calving to 28 days post calving.

The magnitude of this decline varies, but for dairy cows a reduction of 20-30 percent would be typical. This occurs at a time when nutrient requirements are increasing to accommodate the onset of lactation and the rapidly developing foetus. Thus cows are likely to be in negative energy balance at this time and also possibly in negative protein balance. The implications of this for milk production and composition in the subsequent lactation has stimulated research into the effects of protein and energy supplementation in the close-up dry period.

From a theoretical viewpoint and from anecdotal evidence there has been a debate as to the benefits of optimising rumen conditions in the dry period. It has been suggested that supplementation with concentrates close to calving not only increases the energy intake of the cow but it also conditions the rumen and associated microflora so that the post-calving diet can be utilised better. Another suggestion is that including some straw in the close-up dry period diet enhances the physical ability of the rumen to accommodate higher intakes post-calving. This section will summarise the recent Moorepark research on protein and energy supplementation in the close-up dry period and also present some data on straw inclusion in the pre-calving diet.

Protein Supplementation

Some work from the US and Scotland in the mid 90s indicated that there might be a response in increased milk protein production in the subsequent lactation to supplementing with undegradable protein in the final 4 weeks before calving. Two experiments were carried out in Moorepark where supplements of fishmeal (0.5kg each of fishmeal and unmolassed sugar beet pulp per cow per day) and soyabean meal (0.75 kg of soyabean meal and 0.25 kg of unmolassed sugar beet pulp per cow per day) were offered with grass silage pre-calving and where straw was included with grass silage and supplemented with fishmeal as before. The results of both of these experiments are shown in Table 10.

The average lengths of the pre-calving treatment periods were 59 and 46 days in experiments 1 and 2, respectively. There was no response in milk protein percentage or yield to either of the protein supplements before calving, when silage was the basal forage. When straw was included in the pre-calving forage mix (80:20 grass silage:barley straw on a DM basis) supplementing with fishmeal increase milk protein percentage but due to a lower milk yield, protein yield was not affected.

Similar results were reported from IGER at Aberystwyth earlier this year (Dewhurst et al. 2000) using prairie meal as a protein source to supplement grass-silage for 6 weeks prior to calving. Milk yield, protein yield or protein percentage in weeks 2 to 22 of the subsequent lactation were unaffected.

Table 10. The effects of supplementation with protein pre-calving on performance in early lactation (Murphy 1999)

EXPT 1	**Grass-Silage**	**Grass-silage + Fishmeal**	**Grass-Silage + Soyabean Meal**
Milk Kg/day	24.1	23.5	24.1
Protein g/day	772	748	761
%	3.20	3.18	3.16
EXPT 2	**Grass-Silage**	**Grass-Silage + Straw**	**Grass-Silage/Straw + Fishmeal**
Milk kg/day	26.6	27.9	27.1
Protein g/day	852	851	856
%	3.14	3.02	3.12

Energy Supplementation

A number of experiments at Moorepark have investigated the effect on cow performance, both before and after calving, of supplementing with 3kg of concentrates per cow per day in the final 4 to 5 weeks before calving. A lower energy density diet of grass-silage and straw (75:25 on a DM basis) was also evaluated. Results from these trials are presented in Table 11. Post-calving, all cows were offered grass-silage and concentrates.

Cows were on the pre-calving treatments for 35, 28 and 34 days in experiments 1,2 and 3, respectively. In experiments 1 and 2 the responses to concentrate supplementation were small. In the first 8 weeks after calving there was a response of 0.5-0.6 kg of milk and 0.4 g of milk protein per kg of concentrate fed before calving. There was a higher and economic response to pre-calving supplementation in experiment 3 of 1.1 kg of milk and 0.8 g of milk protein per kg of concentrate fed. The better response in experiment 3 may have been due to the fact that all the cows were approaching their second calving as well as being in relatively poor body condition. In both experiments 2 and 3 each pre-calving treatment was divided into two groups after calving which were offered different levels of concentrate supplementation. There was no interaction between pre- and post-calving treatments.

Table 11. The effect of altering the energy density of the diet pre-calving, by supplementing with concentrates or including straw, on cow performance (Ryan *et al.* 2000; Butler *et al.* 1999; McNamara *et al.* 2000)

EXPT 1	**Grass-Silage/Straw**	**Grass-Silage + 3kg/day of conc.**	
[1]**BCS at calving**	2.73	3.0	
Milk kg/day	25.5	26.5	
Protein g/day	800	840	
%	3.14	3.18	
EXPT 2	**Grass-Silage**	**Grass-Silage + Conc (0.7:0.3)**	
BCS at calving	3.27	3.36	
Milk kg/day	22.5	23.4	
Protein g/day	750	780	
%	3.33	3.32	
EXPT 3	**Grass-Silage/Straw**	**Grass-Silage**	**Grass-Silage + 3 kg/day of conc.**
BCS at calving	2.60	2.76	2.88
Milk kg/day	24.1	26.2	28.2
Protein g/day	736	797	874
%	3.16	3.15	3.23

Straw inclusion in the diet

In two of the above experiments it was possible to compare the effects of barley straw inclusion with grass-silage only in the pre-calving diet (experiment 2, Table 10 and experiment 3, Table 11). Straw inclusion pre-calving had no effect on early lactation cow performance in one experiment and significantly reduced it in the second. The dry matter intakes either before or after calving were not significantly different between the treatments consisting of grass-silage and straw or those of grass-silage only as shown in Table 12.

Table 12. The effect of straw inclusion in the diet pre-calving on dry matter intake (DMI) both pre and post calving (Murphy, 1999; McNamara *et al.* 2000)

	Grass-Silage/Straw		*Grass-Silage*
EXPT. 2, TABLE 10	*Straw DMI*	*Total DMI*	*Total DMI*
Pre-Calving	1.7	8.5	9.4
Post-Calving	-	15.8	15.2
EXPT. 3, TABLE 11	*Straw DMI*	*Total DMI*	*Total DMI*
Pre-Calving	1.8	7.4	8.4
Post-Calving	-	13.5	13.8

American work suggested that there was a strong correlation between dry matter intake pre-calving and post calving and therefore maintaining high intakes in the last three to four weeks pre-calving should result in higher intakes post-calving. In the experiment of McNamara *et al.* the correlations were generally weak (Figure 2) indicating that higher intake pre-calving was a poor predictor of higher intake post-calving particularly after the first two weeks in lactation. Also in the first three weeks post-calving the correlation between pre and post-calving intakes were higher for silage only diets pre-calving than the silage and straw diet or the concentrate supplemented diet.

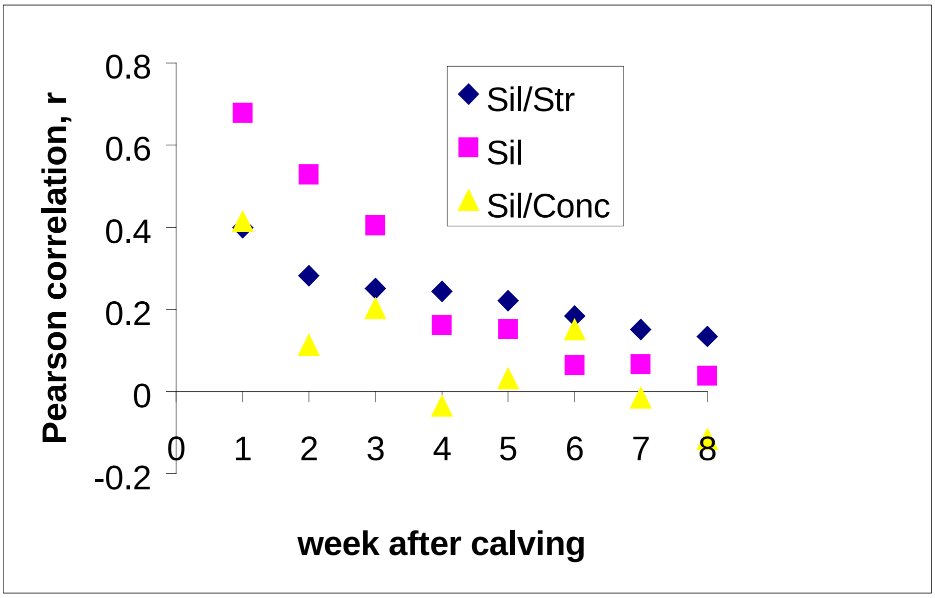

Figure 2. The correlation coefficients between the average DMI intakes pre-calving and the DMI intakes for each of the pre-calving treatments in the first eight weeks after calving.

Outcomes from Transition Feeding Research

- Including protein supplements for up to 59 days, on average, in the dry period did not increase milk production or milk composition in the subsequent early lactation period.
- Including 3kg per cow per day of concentrate supplement in the diet, for up to 35 days on average, before calving did not give an economic response in the subsequent early lactation period, except for cows that were in poor body condition and approaching their second calving.
- Including straw in the diet before calving did not improve dry matter intake or cow performance in the subsequent early lactation period.
- Correlations between pre and post-calving DMI were weak and not as high as those reported from US work, indicating that maintaining high DMI pre-calving on grass-silage based diets does not ensure high DMI in early lactation.

Current Recommendations for Dry cow Nutrition

- Overall the continuing recommendations for nutrition and management are:
- To allow a 10-week dry period for heifers and 8 weeks for all other cows. If animals are in very poor condition coming towards the end of their lactation somewhat longer dry periods can be allowed.
- To attempt to dry off cows in the condition score desired for calving down (3.2 to
- 3.5 on the five-point scale).
- To restrict or supplement the basal silage, depending on its quality and the condition of the cow at drying-off, as outlined in Table 13, for the dry period lengths mentioned above. A dry cow mineral mix should be fed to all cows. A supplement of 12-14% crude protein is adequate with grass silage for dry cows.

Table 13. Recommendations for dry cow feeding

Silage DMD (UFL)	*Body Condition Score at Drying-off*			
	<2.5	2.5	2.75	>3.0
>72 (0.81)	Silage+ 1 kg	Silage *ad-lib*	Silage Restr.	Silage Restr.
68-72 (0.76-0.81)	Silage + 2 kg	Silage + 1 kg	Silage *ad-lib*	Silage Restr.
<68 (0.76)	Silage + 3 kg	Silage + 2 kg	Silage + 1 kg	Silage *ad-lib*

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CUTTING LABOUR NOT CORNERS ON IRISH FARMS

Gearoid MacMahon, Teagasc Cork and Michael Ryan, Teagasc, Athenry

Introduction
Two aspects that are putting pressure on the labour situation on dairy farms are:

1. Financial opportunities outside of farming
2. Increased herd size

The overall trend would indicate that there will be larger one person operated units. While the current average herd size at present (Table 1.) and farming system should not be putting pressure on work-force it is obvious from surveys that farmers are working 60-70 hours per week.

Table 1. Quota Profile 1 April 1999

Quota Band	Number of Producers	Percentage
Less than 35,000 gallons	21542	68
35,000 - 55,000 gallons	6699	21
Over 55,000 gallons	3415	11

Source (*Dept. of Agriculture & Food)*

Spring is a peak labour demand period and this can be streamlined on all farms to a more manageable size.

Many factors contribute to long hours:

- poor work organisation;
- fragmentation;
- poor facilities, etc.

However, irrespective of the scale of enterprise, there is a need to continuously assess the work routine.

- On the small to medium size farms there will be periods of the year (October to January) when off-farm employment could be an option to increase income.

- On the larger farms, one person could be expected to manage 80-100 cows plus followers with some jobs farmed out.

Scope of task

On a typical 50 cow dairy unit, there is an enormous amount of materials to be moved each year.

Table 2. Yearly Movement of Materials / Animals

Material	Quantity
Silage (twice)	700 tonnes
Slurry + Soiled Water	700 m^3
Fertiliser	40 - 50 tonnes
Concentrates	50 tonnes
Milk	60,000 gallons
Group Animal Movements	800 - 1500

Question*:* Do we have to do it all ourselves?
Are we getting best use of our labour?
Are we working for £5.00 or £20.00 per hour?

Job description

Every job involves a range of skills and clear instructions need to be given if they are to be farmed out. For example, spreading fertiliser seems simple but it involves:

1. Manual skills - filling the spreader.
2. Machinery skills - ensuring proper setting of spreader for accurate spreading.
3. Managerial skills - deciding on the need and rate/acre in the first place.

The return per hour of labour increases dramatically as we move from manual £6 to £7 per hour to managerial £50 to £100 per hour. As time becomes more limiting, it is important that farmers devote more of their time to skilled or managerial tasks.

Streamling of farming tasks

Milking

At least one-third of the average working day is spent milking and its associated tasks. On many farms, the actual milking (1st cluster on to last cluster off) takes over 3 hours per day. This is one task over which the farmer has control. The milking equipment and facilities should extract the maximum amount of milk while minimising the risk of infection or injury to the teats in a short space of time, i.e. under one hour in most herds.

Problem Mastitis animals slows milking. A guideline figure is that there should be less than 30 cases of Mastitis / 100 cows / year.

While a small number of units limits throughput in many parlours, it is the work routine associated with milking that is the most important factor in determining the number of cows a milker can milk per hour. This can be as low as 30 in a bad layout / routine system to at least 120 cows milked per milker per hour where certain tasks are omitted while others are automated. In an average herd a realistic throughput is about 60 cows / hour.

Guide to Optimum Number of Units

HERD SIZE	NO. OF UNITS
40	6-8
60	8-10
80	14
100	16
150	20

Essential to Desirable Features

- Bright level entrances and exits;
- Remote opening of exit gates;
- A set of drop-down hoses for washing and teat spray nozzles;
- Batch meal feeding facilities;

- Drafting system from pit;
- Tank in collecting yard;
- High volume low pressure (30-50 psi) pump with pressure operated mechanism;
- Backing gate operated from pit;
- Dump line in large one-man operated parlour;
- Automatic scraping of collecting yard;
- Automatic washing of bulk tank / machine.

Calf rearing

Next spring about 40 calves per farm will be reared with some rearing four to five times that amount. As sick or problem calves take a disproportionate amount of time, no effort should be spared in creating a system and an environment that leads to healthy calves, namely:

- No over-crowding - good ventilation and cubic air space / calf - 6-8m^3 / calf;
- Reduce humidity - use plenty of straw;
- Ensure early intake of Colostrum - use 1^{st} milking Colostrum;
- Moderate feed level;
- Group size 10-15 - automatic feeder 1-3 weeks / mobile feeder 3-8 weeks;
- Use of pump to move milk - 40 calves can drink 500kgs milk / day;
- Early tagging / de-horning;
- Early turnout;
- Pens easily dismantled and cleared with a front-end loader;
- Yoghurt feeding can simplify calf-rearing.

Grassland

Over 70% of the cows' diet and time will be spent grazing grass. This is the period when the cow does most of the work by harvesting some 100 kgs of grass over a 10 hour period per day. Encourage her to continue over the grazing season by putting certain facilities in place.

Essential grazing infrastructures

- A good road surface - some 15 ft. wide for 100 cow herd. Poor surfaces will leave cows walking in a single file and increase lameness. Ideally, the farm road should lead to the collecting yard first rather than cows having to walk through sheds and yards to reach the milking parlours. This is important for those re-siting a parlour.
- Access to all paddocks from a road. This helps cows return to the paddock after milking and training them to come to the parlour as milking approaches.
- Good fencing, especially the boundary, will reduce the risk of "things going wrong" either with stock or neighbours.
- Water in each paddock with a tank capacity of about 3 gallons per cow.

Management practices to reduce the workload

While a good infrastructure will get the cows to and from the paddocks quickly, the provision of quality grass involves spreading fertiliser, the allocation of grass and topping.

Fertiliser: spreading and frequency

Spreading services where they exist should be availed of, especially in Spring when the workload is high and large quantities have to be handled.

Grass gets nitrogen from two sources, fertiliser and soil nitrogen. During the spring and early summer the contribution from soil nitrogen is very low and the response to fertiliser nitrogen is greatest.

Early summer grass growth rates can exceed 80kg. DM / hectare for short periods and it is important to have adequate nitrogen available. The task of spreading can be undertaken every 7 to 8 days without the risk of jeopardising re-growth. From mid-summer onwards, this task can be extended to once per two / three weeks.

Grass allocation

There are numerous grazing systems practised:

- Fresh grass after each milking;
- Twenty-four hour grazing;

- Two day paddocks;
- Three day paddocks;
- Continuous grazing.

Combinations of these also exist with followers cleaning up after cows.

The facts

Increased frequency of grass allocation may increase utilisation and grass recovery but it does little for overall animal performance provided the occupation time does not exceed 2 to 3 days. With short duration grazing periods the performance of the heifers suffers through reduced intake.

Topping

Proper topping is a difficult chore to achieve mid-season due to the prostrate growth habit of many grass varieties. However, it has an important role to play in the provision of quality grass. A lot of the topping practised has more of a cosmetic effect than a real benefit to the pastures.

Main Messages

- Top to 6-7 cms.
- Top only twice or three times in the whole season with the first topping the most important about mid-May and the second around mid to late July and perhaps the last in late August.
- Topping on wet days gives poor results.

Stock management

There are at least five groups of stock on many farms:

- Cows
- In-calf heifers
- Weaning alves
- Beef bullocks
- Beef heifers

The target in the long-term should be to reduce the number of groups to three but in the short-term the inspection of beef animals every second day can be justified provided the fencing is good and they have adequate grass and water. Some farmers are already practising this for the past few years and have rarely encountered an animal requiring immediate attention. Farms prone to red water will still need daily herding.

Winter management

Over 90% of the day's work will be spent around the yard moving materials or animals during short daylight hours. Good appropriate lighting is needed, such as

- sensor-operated, non-glare lighting around the yard, and
- fluorescent lighting within sheds.

Animal Management

The peak workload can be reduced by accelerated cattle finishing. This will lead to less groups of animals, quicker turnover and a simpler life.

Suggested Targets for Finishing:

- Cull cows 50 days
- Beef heifers 60 days
- Heavy cattle 80 days

Target your feeding level to sale date.

- Group treatment only. The smaller the number of groups the easier the management.
- Cull misfits. Prolonged individual treatment takes time, space and patience.
- Keep diets simple and fresh. Careful covering of silage pits will reduce waste and save time at feeding.
- Don't waste time carrying feeds of poor feed value.

Facilities

- Keep animal and machinery routes separate.
- Straight feed and slurry passages are best.
- Storage depots should be close to feed or filling points. This is very important for those with diet feeders. Mini-storage depots are useful where concentrates are being fed at pasture.
- Mechanical handling of concentrates. There are still large amounts of concentrates handled by bag / bucket.
- Winter housing should facilitate flexible segregation, i.e. milkers and non-milkers.
- Secure transit routes to:
  - (a) calving boxes
  - (b) handling crush, etc
  - (c) animal dispatch area
- Have feed passages wide enough (4.8m) to allow mechanical pushing of silage.
- A combination of automatic scrapers and scaper slats can save at least 1 hour per day.

Calving facilities

The calving facilities should be located close to the cow housing, accessible by a secure transit route and the following items available:

- Camera;
- Calving bale;
- Pulley for lifting the calf;
- Water;
- It should be capable of being mechanically *cleaned*;
- Cows should be capable of being fed mechanically;
- Group calving may be appropriate.

Jobs to be Farmed-Out

The following jobs may be shed in whole or in part - but clearly written instructions are important:

- Slurry spreading

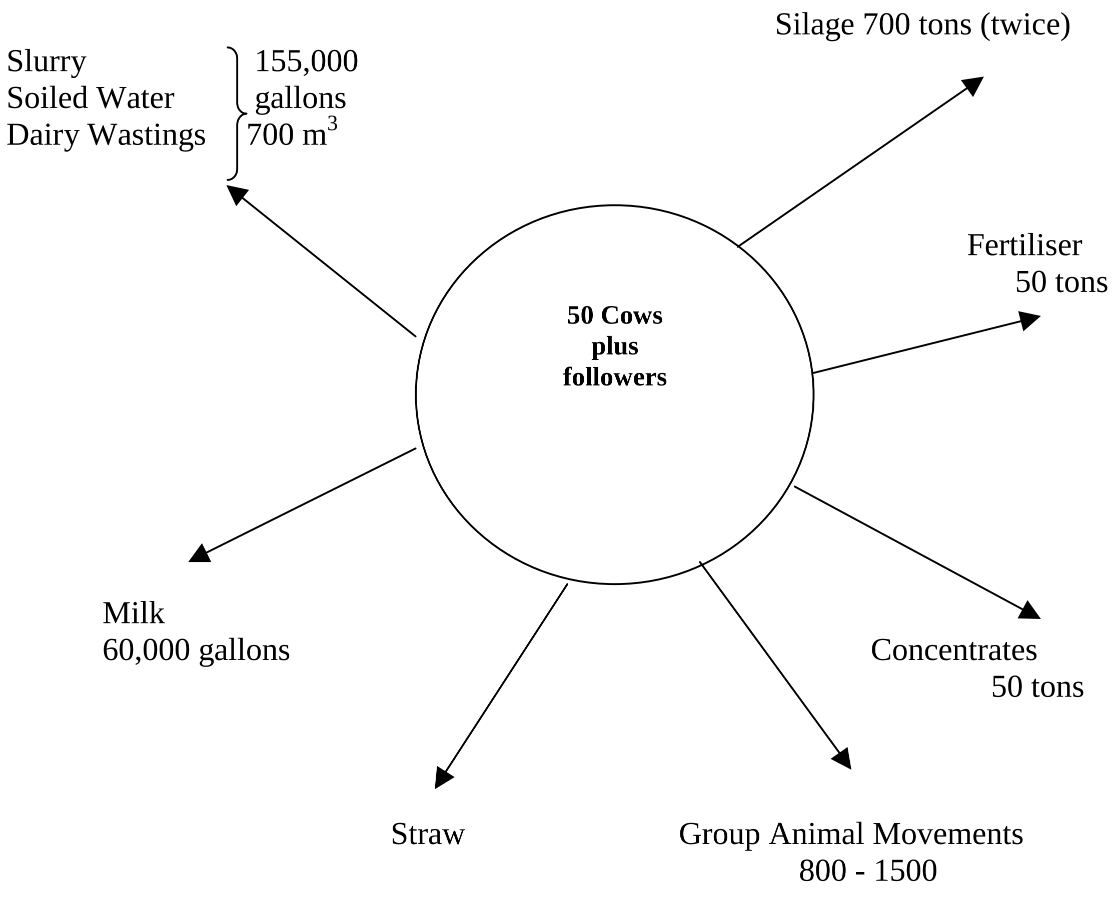
- Fertiliser spreading - especially for the bigger applications
- Silage feeding during periods of peak work demand
- Fencing and in particular boundary fencing
- Specialist metal fabrication could be used for maintenance
- It may be possible to share time if relief milkers are unavailable

Summary

- Keep farming systems simple by striking a balance between efficiency of system and efficiency of labour.
- Devote managerial time to animal performance, breeding, milk yields, l.wt. gain calf rearing.
- Farm out some machinery-related tasks.
- expensive operations - silage-making.
- labour intensive - fencing / maintenance.
- Match facilities to systems? Siting, facilities and vision.

Material movement

Moving 30,000 times your own wt. / year or 7 tonnes / day



Message

- Can the quantities be reduced?
- Can work be farmed out?
- Organisational skills important.
- The Money lies in Milk Extraction.

SECURING THE FUTURE FOR YOUNG DAIRY FARMERS

Kevin Twomey, Dairy Farmer, Ballyhooly, Co. Cork

My name is Kevin Twomey. I am originally from Fermoy where I grew up on a dairy/beef farm. Like many young people growing up on a farm I was out working from a young age. My family has a very strong background in farming from which I developed the love of the land.

After completing my Leaving Certificate in 1989 in St. Colmans College, Fermoy, I faced a very difficult decision. The fact that I had 2 brothers on the home farm, my future in farming as a career looked bleak, but I had options. My options were a four-year B.Ag. course in Dublin or working my way up to a Farm Manager through Agricultural College, followed by the Farm Apprenticeship Scheme. I choose the latter option. I completed a year in Rockwell Agricultural College followed by two years in the Farm Apprenticeship Board with Leslie Boland, Nenagh, Co. Tipperary and Michael Keane, Ardmore, Co. Waterford. I qualified with a Farm Husbandry Certificate. This experience broadened my horizon and opened my mind to new ways of thinking.

Why am I farming? I always had a love of land and animals and a belief that I could make farming a successful career. Being self-employed has always appealed to me. The fact that I am able to plan my own day and organise time off has created a very enjoyable lifestyle. Have young people considered this matter fully before turning their backs on farming? Is this because of parental or peer pressure? To be able to see my own plans succeed has given me great satisfaction.

With the depressed land prices in 1992, in the pre Cap Reform era, my parents purchased a farm of 144 acres in Ballyhooly, which I returned home to farm. Continuing with my education through the Trainee Farmer Scheme with the Farm Apprenticeship Board, I put together a five-year financial and physical plan in which goals and targets were set. The education I received through the Farm Apprenticeship scheme and the completion of the Trainee Farmer scheme at home has been of immense benefit to me.

Starting with tillage and sucklers, I progressed into dairy farming in 1994 as a new entrant buying 10,000 gallons and temporary leasing 35,000 gallons from Dairygold Co-Op. Selling my suckler quota I moved forward and last year I produced 118,000 gallons of which I owned 21,000 gallons and private leased the remainder with all leased land in tillage. Last year I completed an Advanced Dairy Management course in Teagasc, Moorepark, Fermoy. I am a member of two discussion groups: a Dairygold / Teagasc discussion group and a Dairymis discussion group.

I operate a simple grass based system of compact spring calving. Calving from 6 February cows go to grass by day immediately and by night around 1 March as soon as grass cover allows. Cows yielding 1180 gallons at 3.83% fat, 3.35% protein. Common dairy costs are 24.9 p/gallon. This year infertility averaged 8%

Looking to the future, I believe there are 3 key factors to securing the future of young dairy farmers:

1. Expansion
2. Processing
3. Marketing

Expansion

The education, research, and on-farm advice available in Ireland is first class. However there needs to be a clear path of opportunities to expand and grow the business. The recent regulation changes have meant that private leasing has ceased, the pool of temporary leasing has diminished and the quantities of restructuring milk are small. A young farmer cannot do now what I did five years ago. There is a need for a radical change in quota management. It is a must that young farmers can see clearly a means to progress forward, a system that can be structured with or without the quota regime. The French, Danish and New Zealand structures are well published and work within their own domain. I believe Ireland's way forward is through both simple partnerships and equity partnerships. Simple partnerships are where two farmers amalgamate to increase profits and reduce labour. Equity partnerships are to cater for larger scale farmer and worker. The worker puts up a little capital and labour for a set percentage of ownership and profits.

1. Processing

The second factor that will have an immediate effect on young farmer's progression, is the processing industry. All farmers must share the blame in that our processing industry has not progressed. There is a need for a revamp in the structure of co-op boards. A rotational system should be implemented to remove almost life members of whom many may not be actively farming, and replaced with active progressive and motivated young farmers that have the attitude and courage to rationalise the industry.

The future direction of Ireland's dairy industry will be set by actions taken over the next few years. If we do nothing, we will face the world commodity markets with an un-competitive cost base. Scale consolidation can improve our competitiveness but if pursued with the single objective of cost reduction, will drive our industry into an inflexible commodity corner with little potential to generate a margin above basic bulk value. Scale consolidation, accompanied by a strategy for product diversification, will bring cost economies for bulk products, but its most important consequence would be to provide the resources and marketing power to achieve greater product diversification and value added. Whichever course of action is pursued, the industry faces major capital investment in advance of the free market. The farmer who has the interest of the industry at heart should consider how he might finance future changes to suit the best interest of the present and next generation of dairy farmers.

With milk prices returning to their 1996/97 heights, it's time to bite the bullet and re-invest strategically in the dairy processing industry through the co-operation of the co-ops.

2. Marketing

The third factor effecting the future of the dairy industry is the lack of marketing and product development. Most of this blame lies in our own hands, as the Co-Op and plc management have not invested sufficiently in R & D and Marketing. The number of new on the shelf consumer value added products, developed in the last decade has been very disheartening. I am sure you are familiar with two, Cheesestrings and Dubliner Cheese. Ireland is much more dependent on commodity products compared with the E.U. neighbours and therefore we are more exposed to price cost pressures squeeze.

Do we care about the market place? In many ways as farmers we have distanced ourselves from the market place. It is only a couple of decades ago when every farmer was within 10 to 15 miles of his market, where produces were sold from farmer to consumer. This link needs to be re-established. Farmers must be seen to farm in harmony with the environment and animal welfare. Ireland has a good track record in this regard. We need to build on this strength.

Who has been selling the bulk of our product on the world market? The Irish Dairy Board. What is the dairy farmers' perception of the Irish Dairy Board? As dairy farmers we pay 0.5p/gal towards its running cost, costing me £5 per cow. This is the same as the detergent cost to run my parlour. Yet as farmers we know very little of the Dairy Board functions. There needs to be a more integrated approach by farmers, processors and the Irish Dairy Board. Should a much more active marketing strategy be implemented? Will this strategy lead a move to more value added products? This can only be achieved through an adequate investment of £12to £15 million in R. & D. There should also be a revamp of the Irish Dairy Board to incorporate younger highly skilled marketing management graduates into middle and top management. It is amazing the wealth of skills and resources young Irish people have. A former classmate of mine in St. Colmans College is now the Marketing Manager of New Zealand Diary Board, working on Middle East and African projects.

To summarise, there are many decisions outside the farm gate that will influence dairy farmers' future. However, we do hold the greatest influence of all. We are the voice that can direct our processors and marketing personnel. We young farmers in particular who have put in our time to receive an excellent training and education from both Teagasc and Farm Apprenticeship Board need to be rewarded. Clear paths to progress must be laid down for us to reach our goals and targets set down in our plans. I believe that if our processors and marketing personnel are as highly trained and committed as us young farmers, there is a very bright future in store for the Irish Dairy Industry. With grazed grass providing the base of simple spring compact calving systems and the remainder moving to 100% autumn calving, there is a means of an extremely good lifestyle, good income and great future.

DANISH DAIRY INDUSTRY 2000

The primary sector – structural development – the quota system

At the introduction of the EU quota system in 1984, a number of objectives were drawn up regarding the implementation of the system in Denmark. Sixteen years later these objective are still unchanged, but the measures and policies have been gradually adjusted following the trend of events.

One main objective was to separate the individual dairies/dairy companies from the quota system. This was achieved by establishing the Danish Milk Board in 1984. The Danish Milk Board has two main functions:

- To be sole purchaser of milk from producers and resell the milk to dairies, and

- To manage the quota scheme on behalf of the Ministry of Food and Agriculture and fisheries and the Danish Intervention Board.

Since 1984 the dairy processing sectors has experience a quite dramatic structural development, leaving only one large dairy – Arla – which receives 19% of the milk intake and a large number of small local dairies. During the entire period neither large nor small diaries have been involved in the quota scheme. They have been able to focus on their core business – production and sale of milk and dairy products.

Another main objective was that the quota scheme should affect the development of the primary sector as little as possible. A quota system tends to have a somewhat reactionary effect on the structural development. The structural development inside a quota system with prohibitive levies in the case of quota excess will either demand an extensive bureaucratic reallocation system or imply capitalisation in connection with reallocation of quotas.

At the introduction of the quota system in Denmark in 1984, 34,5000 producers were allocated quotas for milk production. In the following years, the EU financed outgoers' schemes were introduced to get the structural development started. In 1989, the number of producers had declined to 22,000. At that time, a new reallocation scheme was introduced in Denmark enabling all milk producers to sell and purchase at a politically fixed price. But politically fixed prices will always be wrong – either too high or too low compared to market prices.

In Denmark the politically fixed price was too low, and the result was that the supply was too low and demand too high. In fact, the demand was so high that the available quantities had to be equally allocated between the buyers at the low price. The actual quota increase for the buying producers amounted to 2% to 4% per year. This was satisfactory to the producer who just wanted to maintain status quo, but for producers who wanted to invest and develop, the system failed. The young enterprising producers tried to purchase or lease quota with land from neighbouring farms. This was quite legitimate and was extensively common. Prices went up and the option of land management became inappropriate.

In 1996, we analysed various models of quotas and particularly the Canadian reallocation system was inspiring, where a quota exchange scheme was introduced in 1992. In Canada too, they had tried various quota reallocation systems, without achieving optimal functions.

We drew up following subsidiary objectives for a future quota reallocation system:

- A five-year agreement between the relevant agricultural organisations.
- The flexibility in quota reallocation should be increased.
- The ties between land and quota should be broken.
- Commercial producer investment should be favoured.
- Prices of quota should be fixed by the market to minimize capitalisation.

- Geographical equalisation of producers.
- The administration of the quota system should be simplified.

We found that the means to achieve the objectives was the quota exchange.

After three years and six quota exchanges, we have just completed an analysis, showing that our original objectives have now been reached. The total reallocation of quota was 757 million kg (or 17% of the total Danish national quota) from 1998 to 2000. Approximately 1,000 new cow houses have been built, with room for 125-200 cows in average. The latest forecasts indicate that plans for an equal number of cow houses are being made. This must be seen in relation to the fact that in 2005 we expect to have 6,000 milk producers left with an average quota of approximately 750 tons or approximately 100 cows on average.

Based on the above, the Danish Family Farmers' Association, the Danish Farmers' Unions and the Danish Dairy Board have recently signed a new four-year agreement on the Danish quota policy, with effect from 1 April 2001. We expect our Minister for Food and Agriculture will approve the agreement.

The quota exchange scheme will continue, but an important change will be that any milk producer regardless of size may purchase 300 tons quota over a four-year period. The former agreement has restricted the purchasing options of large producers, with quota over 900 tons, to twenty-five per year.

The rules and conditions for young mild farmers will be improved. A young milk farmer can buy and partly get quotas up to 860 tons. 25% to 30% will be free of charge. The quantities free of charge come from a deduction scheme (drawback) in case of direct transfer of quotas and now a 1% drawback on total transaction of the quota exchange.

Our experience from the first three years indicated that we can liberate reallocation of quotas even more without increasing capitalisation drastically, and, which is good news for all liberal farmers, the administration of the quota exchange is extremely simple. We normally have 4,000-6,000 producers who give their bid to the Milk Board, just filling in the quantity they want to buy or sell, the maximum price or minimum price, and their signature. Three to five days after deadline, we can publish the market clearing price and inform the producers who have bought or who have sold. T he turnover since we started has been 2.2 thousand million DKK equal to EUR300 million and up to now, we have never lost a penny.

The Processing Sector – Structural changes in production and export

Throughout the 1970s and 1980s, Danish dairy exports were split between the EU markets by one third and the third country markets by two thirds. During the 1990s, this division changed drastically, especially the Danish cheese exports, as 705 is now sold within the EU and remaining 30% to third country markets.

In particular, the upgrading f the German market from the start of the 1990s has produced the required effect. Value added processing and careful selection of product ranges/brands were the efficient cause together with substantial investments in marketing in Germany. Other examples of markets in progress are Spain and Greece, where attempts are made to market specific speciality cheeses as well as selected cheese types, tailor-made for these markets.

The drastic change of the export structure is mainly a result of strategic planning by Arla Foods, previously MD Foods, which has had the power to effect and develop the strategic efforts. In a future liberalised diary market, it will be a strength to have the main outlet at the nearby markets with a constantly increasing demand for the principal product, cheese.

To a large extent, the development is also provoked by the requirements of the GATT agreement for reduction of subsidised exports. At the implementation of the GATT agreement in 1995, one third of the EU cheese exports originated in Denmark. This share has now been reduced to 15%. Another major factor causing the turn of exports towards the EU market is the development of the export of Feta cheese to Iran. From being a primary market receiving 75,000 tons of Danish Feta cheese at the end of the 1980s, Feta exports have now practically vanished.

Nevertheless, Danish dairy still depends much on third country exports. Refunds total 1.30 thousand million DKK annually, equalling 12% of the milk production value ex far. Approximately 60% originates from exports for whole milk powder, which is practically for third countries only. Despite a considerable diversification, it is unrealistic to expand sales within the EU.

Besides, there is still a continuous important export of cheese to USA, Japan and the Middle East as well as butter for Saudi Arabia.

Future prospects for the Danish dairy sector

The merger between MD Foods and Kløver Mælk has literally put an end to the structural development within the dairy industry in Denmark. The process of rationalisation is not yet completed, but is well on the way. One of the final steps is the opening of a new dairy plant this autumn, centrally situated in the most milk-dense region in Denmark. At the initial phase, the dairy is dimensioned for 25,000 kg of ordinary cheese, but the future potential is two to three times this quantity.

The merger between MD Foods and the Swedish co-operative Arla has created the largest dairy co-operative in Europe. It has a milk intake of 7 thousand million kg. 16,7000 members, 8,900 of which are in Denmark and 7,800 in Sweden, own the co-operative society. If this cross-border merger between two co-operatives succeeds, it is unlikely to be the last.

However, there are still a considerable number of small dairies in Denmark. Some are living on borrowed time. Others, including a number of farm dairies, benefit from the polarisation between mass-produced, convenience products and the demands from political consumers to know the origin and originality of a product. This makes way for niche products to a large extent based on special, high price contracts with the retail trade.

Organic production has reached a considerable level in Denmark. We have now 725 organic milk producers, who supply 400 million kg milk. However, consumption of liquid milk seems to have peaked at a saturation point of 20% to 25% of the total sale of liquid milk. The economy of organic production is suffering, as the sale cannot keep the pace of production. The present surplus supply of the market for organic milk has stopped accession of new organic producers. The aim is now to increase the utilisation rate by intensifying exports to the closest markets in Europe.

An active quota policy is necessary to ensure a continuous structural development at producer level, and to secure an efficient reallocation of quotas to the most effective producers. Danish milk producers are very aware that the protection of the quota system may vanish, when and if the quota system is phased out, perhaps in connection with the enlargement of the EU by the Eastern European countries.

Danish industry will elevate and consolidate its position as the most rational and efficient in the EU as producer level and industrial level. We believe we have a raison d'être also in an even further liberalised market situation (WTO II) as supplier of high quality products for the most demanding and profitable markets.

No doubt the enlargement of the EU by the Eastern European countries will be the greatest challenge in the next couple of years. After all, we see more options than threats in this respect. The anticipated increase in competition in connection with enlargement will be in the bulk market and will not primarily affect the Danish dairy industry – on the other hand, markets will open requiring highly processed quality products, 'Western commodities'.

LABOUR ON DAIRY FARMS – THE SPRINGTIME CHALLENGE

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Introduction

This paper presents some of the early findings of the research work being undertaken by Teagasc and UCD on dairy farms in Ireland related to labour use and efficiency. It presents data from the 'spring' (February to April) period of 2000 and in particular highlights labour demands as they vary across months and with particular tasks.

Background

Maintaining and optimising the use of labour is one of the major challenges faced by dairy farmers throughout the country. While changes in the agricultural economy and workforce are inevitable, actions are required to manage such changes and direct them in a manner which fortifies the future of the industry as a vibrant and sustainable entity. On farms this means incorporating 'user-friendly' systems, which meet the challenges of increasing consumer demands, market competitiveness, more stringent environmental regulations and a more demanding workforce. As farmers confront this challenge, the current labour shortage emerges as a central issue. The pulling power of the Celtic tiger and the 'nature of farm work' are resulting in falling levels of both hired and family labour.

The total farm labour force has decreased from 324,000 in 1992 to 269,900 in 1999; a decline of almost 17% (Frawley, 2000). Agriculture as a percentage of total employment has fallen from 23% in 1975 to 10 % in 1997. It is projected to fall to 4% by 2010 (Agri Food 2010). The decline in the number of people working in farming can be attributed mainly to farm workers opting for either industrial or service-sector employment. This movement of farm workers out of farming is at twice the rate of farm holders and or operators (Frawley, 2000). At present, careers outside farming are perceived to be superior to those within farming, due to:

1. Low and variable farm incomes, compared to the industrial wage;
2. Unattractive working conditions;
3. Disruption of leisure time by unsociable working hours (Frawley, 2000).

Research design

The three year research programme is being undertaken by Teagasc, Moorepark and the Faculty of Agriculture, UCD together with over 140 dairy farmers. The programme began in October 1999 and aims over its lifetime:

- To establish the facts about labour use on dairy farms;
- To identify farm tasks in which labour efficiency can be improved;
- To test a number of improved labour efficient practices on farms with a view to establishing best practices for wider dissemination.

Year 1 of the on-farm research (February 2000 to January 2001) is concerned with establishing the tasks undertaken on dairy farms throughout the year and the time associated with these tasks. The outcome of this is to identify the tasks which lend themselves to being undertaken in a more time-efficient manner and to propose on-farm 'labour-efficiency' changes which would be tested on a small number of farms in Year 2.

The research work in Year 1 is being undertaken on a total of 141 farms, mainly in the Munster area. These farms have at least one full time operator and the distribution of farms by quota size is given in Table 1.

Table 1: Distribution of Labour Study Farms by Quota Size (141 farms)

Quota size ('000 gls)	**%**
30-55	25
55-72	25
72-130	25
130-320	25

On-farm data in Year one is collected in two ways. Ninety-eight farms are recording measurements on a timesheet for a consecutive 3-day period, once every month. The measurements include the total time consumed by each task on a daily basis. The remaining 43 farms record measurements on data loggers for a consecutive five-day period, once every month. In addition to task duration, this method also indicates the time of day that the task took place, the length of the working day and free time available during the working day. This method allows each person working on the farm to record their labour input on an individual basis.

In addition to the timesheet and data loggers, two questionnaires have been completed covering all of the practices / tasks which take place on farms over the winter housing, spring calving and early summer periods. These incorporate questions regarding the ways/routines in which jobs are carried out, and the facilities in place. A survey of farm fragmentation and layout has also been completed on each participating farm. All farmers involved in the programme were invited to a workshop in April 2000 which identified and prioritised the areas in which they felt labour could be more efficiently used.

Preliminary results

The results shown in this section are derived from data collected from 89 farms which are a subset of the 141 profiled in table 1(which used timesheets to record labour use) during the spring period of 2000 (February to April). It should be noted that the labour recorded on these farms represents that contributed by the farmers themselves, other family members and, where relevant, hired workers. On 34% of the farms there was hired labour. These farms were 100% spring calving and had an average total milk quota of 75,000 gallons, which ranged from 30,550 to 282,000 gallons. The data in Table 2 gives the total labour input for the months of February to April together with a breakdown of labour by the main farming activity.

Table 2. Average total labour input (hours:minutes) per day by main farm tasks in February, March and April 2000 (89 farms)

	Month		
	February	March	April
Average total labour input per day	9:53	12:17	11:13
***Tasks:**			
Milking Process	2:25	4:08	4:39
Calf and cow care	2:25	2:53	1:41
Yards, buildings and machinery (cleaning and maintenance)	1:45	1:32	1:28
[1]Other farm tasks (veterinary, grassland management etc)	1:10	1:46	1:50
Other enterprises	1:14	1:09	0:44
[2]Management including office time	0:54	0:49	0:51

[1] *'Other farm tasks' includes all other work related to the dairy enterprise and represents more than 10 minor tasks.*

[2] *'Management including office time' = Advisory, office work, trading stock.*

The data in Table 2 shows that the total labour input for the farm system increased from an average of 9 hours 53 minutes for the month of February to a maximum of 12 hours and 17 minutes in March. The daily labour input declined again in April. As the milking process, calf and cow care as well as cleaning and maintenance work consume the majority of the labour input on dairy farms in the spring period, each is dealt with separately and in more detail in the following sections.

Milking Process

Milking and associated tasks are an important component of the working day. The data in Table 3 gives a more detailed breakdown of the time associated with the milking process.

Table 3: Average times (hours: minutes) associated with the milking process and related tasks per farm in February, March and April, 2000 (89 farms)

	Month		
	February	March	April
The Milking Process	2:25	4:08	4:39
Tasks:			
Milking	1:01	2:04	2:30
Washing up yard and milking machine	1:00	1:22	1:27
Herding cows before milking	0:15	0:25	0:27
Herding cows after milking	0:09	0:17	0:15
Average number of cows milking	18	47	65
Cows milking as a % of predicted mid-summer herd size	28%	70%	95%

The actual time spent milking cows increased from 1 hour in February to 2 hours and 30 minutes in April. The increase in the labour required for milking was associated with an increase in the number of cows milking across the three months. Milking time accounted for 42%, 50% and 54% of the total time associated with the milking process for the months of February, March and April respectively.

At the workshop held last spring, design and capacity of the milking parlour and facilities were regarded by farmers to be critical elements of the labour requirement described. More specifically, cow flow and drafting were identified as areas with room for improvement. Participants also felt that farm layout and fragmentation affected the movement of animals greatly.

Calf and Cow Care

Table 4 shows the time requirement associated with calf and cow care and its breakdown by related task.

Table 4 Average times (hours: minutes) associated with calf and cow care with and calf feeding and management and related tasks per farm in February, March and April,2000 (89 farms)

	Month		
	February	March	April
Calf and Cow Care	2:25	2:53	1:41
Tasks:			
Feeding cows/silage pit management	1:03	0:49	0:15
Calving/monitoring cows	0:31	0:36	0:12
Calf care	0:51	1:28	1:14

Calf and cow feeding and management showed a labour demand peaking in March at 2 hours 53 minutes. In February, feeding cows and silage pit management consumed a major portion of this total, while as less cows were housed over the following months and calf numbers increased, calf care emerged as the most time consuming task.

Those who attended the workshop identified the duration of the housing period for calves as a major part of the labour required for calf rearing. The main areas for improvement were identified by farmers as: design of calf houses and cleaning system for houses; calf feeding: including collecting the milk; distance from parlour; methods of feeding; and calf health including grouping of calves.

Yard and Machinery

Table 5 shows the time associated with yards, buildings and machinery maintenance with regard to their cleaning and maintenance and their breakdown by individual task.

Table 5 Average times (hours: minutes) associated with cleaning and maintenance work and related tasks per farm in February, March and April, 2000 (89 farms)

	Month		
	February	March	April
Yards, buildings and machinery (cleaning and maintenance)	1:45	1:32	1:28
Tasks:			
Cleaning yards/houses	0:29	0:20	0:12
Cleaning cubicles	0:23	0:19	0:04
Land and buildings maintenance	0:38	0:45	0:58
Machinery maintenance	0:15	0:08	0:14

The average total time consumed by yards, buildings and machinery work declined over the 3 months, from 1 hours 45 minutes to 1 hours 28 minutes. Time consumed by cleaning yards / houses and cleaning cubicles fell dramatically over this period as many cows were left out to grass as the months progressed. Maintenance of land and buildings increased over this period as cows going out to grass necessitated the repair of gates, permanent fences etc.

The next steps

As this three-year research programme is a work in progress it is important to interpret the findings to date in the context of where the programme is going over the rest of its lifetime. Data collection on the 141 dairy farms will continue up to the Spring of 2001 with the purpose being to ensure that the labour profile for the entire farming year is collected. The next step within the programme will be to analyse the data to determine the average month by month labour usage and the tasks in which labour is invested. The analysis will also begin to highlight the key areas where dairy farmers could make changes with a view to enhancing the labour usage on their farms.

All farmers involved in the programme will be provided with an individual report on their own farm which profiles their situation regarding labour use and will enable them to identify the areas on their own farms where labour efficiencies might be improved.

The second year of the programme will work closely with a relatively small number of farms from the original group of 141. These farmers will plan and undertake certain changes on the basis of the analysis from Year 1. The changes being carried out by these farms will be closely monitored by the research programme and will form the basis for establishing 'best practices' related to labour efficiency on dairy farms into the future.

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